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PERCUSSION FIGURES IN CRYSTALS

SIR C. V. RAMAN

THE impact of elastic solids was the subject of investigation by the author many years ago. The earliest of his publications on the subject which appeared in the *Physical Review* for December 1918 recorded the discovery that the coefficient of restitution in the impact of elastic solid spheres tends to unity as the velocity of impact diminishes and becomes small, a result which could have been anticipated from theoretical considerations. His second paper which appeared in the *Physical Review* for April 1919 considered the problem of 'the impact of spheres on elastic plates of finite thickness but of extended area. It was shown theoretically and confirmed experimentally that the kinetic energy of the impinging sphere is transferred to the elastic plate as energy of wave motion to an extent determined by the thickness of the plate and that as a consequence, the coefficient of restitution diminishes progressively from unity for thick plates to small values for thin ones.

In the course of the studies referred to above, the remarkable effects arising from the impact of a polished sphere of steel on the surface of a thick slab of glass came under the notice of the author. They were described and illustrated in a note published in *Nature* of the 9th October 1919. Some further studies of the same effect were later reported in the *Journal of the Optical Society of America* for April 1926. It had long been the intention of the author to return to the subject and investigate the effect of impact of spheres on crystal slabs. Only recently, however, did this intention materialize. Studies have been made of the results of the impact of polished steel spheres of appropriately chosen size on the optically polished surfaces of quartz, calcite, barytes and felspar. The results of the study show clearly that though the size of the sphere and the velocity of the impact are important factors, the gene-

ral nature of the effects observed is a characteristic property of the crystal itself and is related both to the structure of the crystal and to the orientation of the face on which the impact occurs. The importance of the subject is thereby made evident and a wide field of research is opened up. It is proposed to give here a brief account illustrated by selected photographs of the results of the research. The interested reader will find a more detailed account and many more illustrations in the paper published by the author in the *Proceedings of the Indian Academy of Sciences* for December 1958.

2. PERCUSSION FIGURES IN GLASS

It is useful to commence with a brief account of the effects observed when a polished steel sphere is dropped on the smooth surface of a thick slab of glass from an appropriate height. The most striking feature of the percussion figures observed in the glass is a fracture which is symmetrical in shape and extends inwards from a ring-shaped crack on the surface to a sharply defined limit in the interior. The fracture exhibits interference colours both in transmission and by reflection, these being complementary to each other. A remarkable feature is that the area over which the sphere and the glass come into contact during the impact exhibits no visible damage, and indeed only with difficulty can one perceive by passing the finger over the surface of the glass that the impact has had any effect at all. The ring-crack from which the internal fracture spreads inwards is however readily visible at the surface, and a critical examination by reflected light also reveals a slight elevation of the surface round the crack, as is naturally to be expected from the presence within the glass of fracture surfaces which are separated from each other. This effect is however best exhibited by placing a test plate of glass over the percussion figure and

observing the interferences between the lower surface of the test plate and the upper surface of the glass slab by reflected light. Monochromatic light, *e.g.*, that of a sodium lamp should be used for the observations. The phenomenon of which a photograph is reproduced as Fig. 1 (a) is then observed.

around the area and slopes down gradually to the original level on all sides, as is shown by the configuration of the closely spaced circular interference rings.

3. PERCUSSION FIGURES IN QUARTZ

The nature of the results observed with quartz is found to depend notably on the

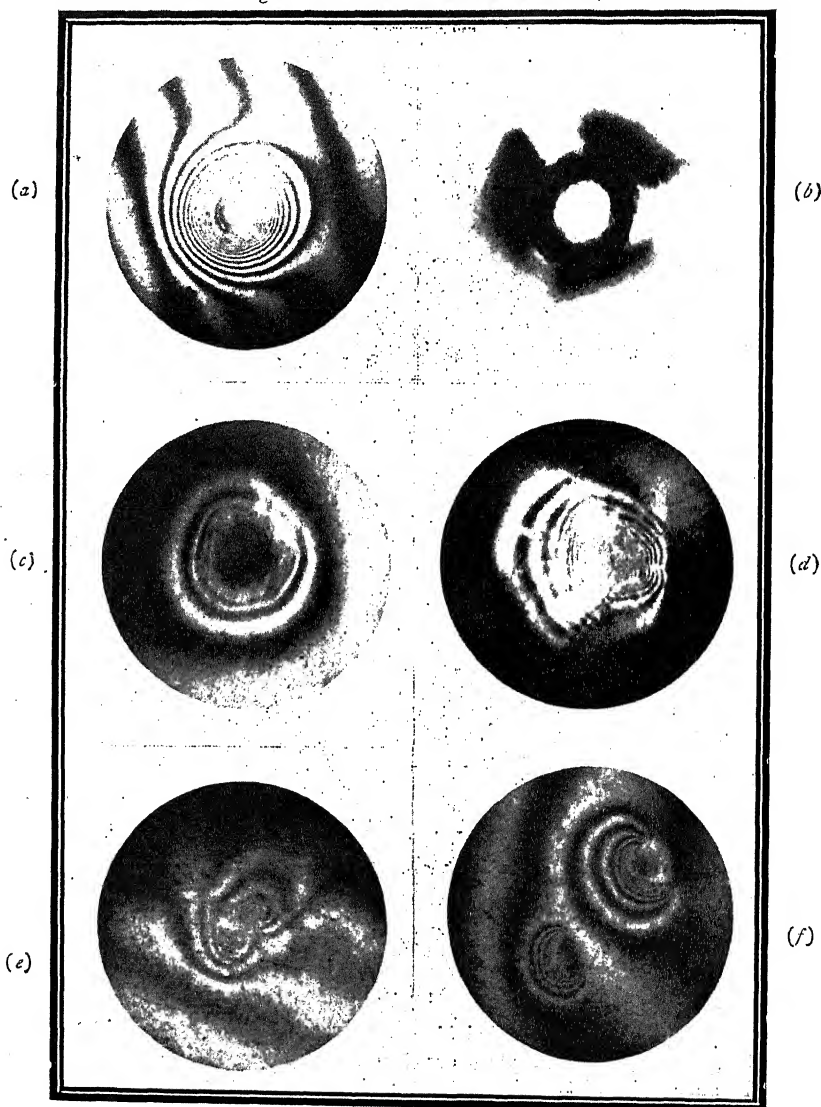


FIG. 1. Percussion Figures.

At the centre of the figure is seen the undamaged area of the surface bounded by the circular ring crack. There is then a sudden elevation of the surface which is symmetrical

orientation of the surface on which the impact occurs. The most interesting results are those noticed when this surface is perpendicular to the optic axis of quartz.

Figs. 1 (b) and 1 (c) reproduce photographs of the percussion figure observed in this case, Fig. 1 (b) representing what is observed by transmitted light and Fig. 1 (c) being the interference rings observed when a test plate is laid on the slab of quartz over the percussion figure. Fig. 1 (b) exhibits the very striking fact that the fracture surface inside the quartz exhibits only trigonal symmetry and *not* hexagonal symmetry. This feature is further evident from the nature of the elevation of the surface as revealed by Fig. 1 (c). There are, of course, many other features noticeable in the photographs reproduced, but it is not possible to refer to them here in detail. They will be found fully set out and illustrated in the detailed paper referred to above.

4. PERCUSSION FIGURES IN CALCITE

Figure 1 (d) illustrates the effect of dropping a small steel sphere on the rhombohedral face of a crystal of calcite which had been smoothed and polished to optical perfection. The photograph was taken with a test flat laid on the surface and allowed to settle down. Much the same features are also exhibited by the percussion figure itself without a test plate. An examination of the percussion figure reveals that the characteristic cleavages of calcite play an important role in determining the results of the impact. Indeed, it is observed that on either side of the area of contact between the impinging sphere and the crystal, two cleavages making an acute angle with each other develop and

extend outwards from the edges of that area. These cleavages are clearly visible on the face of the crystal and they sharply limit the area within which the fracture develops and spreads inwards. Another interesting feature is the appearance of a whole series of parallel lines outside the region of contact and only on one side of it. These lines are equally inclined to the two sets of cleavages and may be explained as due to glides occurring within the crystal along the direction of a rhombohedral edge.

5. PERCUSSION FIGURES IN OTHER CRYSTALS

Quartz and calcite are specially suited for studies of the kind described, since it is possible to obtain fairly large specimens which are clear enough to enable the results of the impact within the crystal to be satisfactorily observed. In other cases, it is not so easy to find material of this quality which could be used for such studies. There is usually no difficulty, however, in obtaining single crystals of the desired size on which surfaces of the desired orientation can be cut, ground and polished to optical perfection. The results of the impact on the *external* surface can then be readily studied by placing a test plate on it and observing the configuration of the interference patterns seen in monochromatic light. These patterns are found to be highly characteristic of the material studied as well as of the chosen orientation of the surface. Fig. 1 (e) in the plate shows the pattern observed with barytes and Fig. 1 (f) with felspar.

THE INDIAN ACADEMY OF SCIENCES

AT the invitation of the Maharaja Sayajirao University, the Twenty-Fourth Annual Meeting of the Academy was held in Baroda on the 27th, 28th and 29th of December 1958.

The function which was held in the Central Hall of the Baroda College before a large and distinguished gathering was inaugurated at 17.30 hrs. on the 27th by His Highness Maharaja Fatehsinh Gaekwad, Chancellor of the Univer-

sity. In a felicitous speech His Highness appealed to the scientists "to fashion their work in such a way that its results would be useful for bettering the life of the common man." The ultimate aim of all sciences, he said, is and ought to be the well-being and all-round progress of humanity. Earlier Dr. J. M. Mehta, Vice-Chancellor of the University in his welcome address referred to the relation between

Science and the State and the role of the Universities in this connection.

Sir C. V. Raman, President of the Academy, then introduced the Fellows present and delivered his Presidential Address on "The Infra-red Spectrum". In this address he outlined a new approach to the explanation of the infra-red absorption spectra exhibited by molecules and crystals, basing it on the fundamental notions of the quantum theory. A detailed account of the theory will appear in a later issue of *Current Science*.

On the second day, the morning session opened with a symposium on "Elementary Particle Physics" under the chairmanship of Dr. S. Bhagavantam. The symposium was started by Dr. Alladi Ramakrishnan with his introductory address on "Propagators and virtual states". The other papers presented at the symposium were "Three fundamental representations of quantum field theory" by G. Ramachandran; "Quantum mechanical aspects of angular momentum" by V. Devanathan; "Angular correlations" by R. Vasudevan; "Weak interactions" by N. R. Ranganathan; "Chew's theory of meson interactions" by K. Venkatesan; "Nucleon-nucleon interactions" by Dr. S. K. Srinivasan.

In the afternoon session at the scientific meeting in Section A, a number of papers were presented and discussed. Sir C. V. Raman spoke on "Percussion figures in crystals". A report of his address appears elsewhere in this issue. Dr. K. S. Viswanathan presented the results of a mathematical investigation on "The relativistic theory of chemical binding". Applying Breit's equation for a hydrogen molecule (or for a system having cylindrical charge symmetry) the total angular momentum component along the molecular axis comes out as a constant of motion and as such every eigenstate of energy of the system can be specified by only one parameter, namely, the eigenvalue of the total angular momentum along that axis. Prof. A. Jayaraman delivered an address on "The iridescent feldspars" in which he presented the results of optical and X-ray investigations, including especially the effects of heat treatment on the structure of these feldspars. Dr. D. Krishnamurti presented the results of an investigation by him on the Raman spectra of $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (tetragonal and

monoclinic forms), $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ (orthorhombic) and $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ (monoclinic). The full report on this work has appeared in the December 1958 issue of the *Proceedings of the Academy*.

The other papers presented at the meeting were: "Condensation of 4-Nitro-O-phenylene diamine with aromatic aldehydes" by Dr. N. V. Subba Rao and C. V. Ratnam; "Solar and climatic data for building design in India" by Dr. T. N. Seshadri; "The effect of ionization on the grains of a nuclear emulsion" by Dr. Yog Prakash; "Specific heats of metals at liquid helium temperature" by Dr. K. G. Ramanathan.

In the evening there was a public lecture by Dr. N. Kesava Panikkar on "Indian Fisheries".

On the third day, there was the scientific meeting in Section B, at which Prof. T. S. Sadasivan took the Chair. He delivered an address on "The problem of blast disease of rice", a summary of which appears elsewhere in this issue. This was followed by an interesting lecture on "Cytogeography of some Indian plants" by Dr. E. K. Janaki Ammal.

Dr. R. Subrahmanyam presented the results of his work on "Phytoplankton of the west coast of India" which extended over a period of six years. He dealt with all aspects of phytoplankton production and the factors affecting the same, as well as with its effect on the economy of the waters of the West Coast of India. Prof. R. V. Seshaiya spoke on "Some aspects of estuarine hydrology and biology".

In the evening Dr. S. Bhagavantam, Director of the Indian Institute of Science, Bangalore, gave an illustrated lecture on "Sounds we cannot hear".

At the special request from the public of Baroda, Sir C. V. Raman stayed over for the 30th December and gave an evening lecture on "Diamonds".

At the business meeting of the Academy held on 27-12-1958, the following were elected to the Academy:

Honorary Fellows.—Prof. J. Bjerknes, U.S.A.; Prof. Jaroslav Heyrovsky, Czechoslovakia; and Academician A. F. Joffe, U.S.S.R.

Fellows.—Messrs. K. Chandrasekharan, D. Krishnamurti, S. Pancharatnam, V. Prabhaker Rao, K. Subramanyam, M. S. Swaminathan and B. V. Thosar.

OBITUARY

SIR MIRZA M. ISMAIL

THE death of SIR MIRZA M. ISMAIL on the 5th of January 1959 at his residence "Windsor Lodge" in Bangalore came as a rude shock to his many friends and admirers in the country. Sir Mirza was seventy-five years of age and was apparently in good health. The end came very suddenly through an attack of coronary thrombosis.

Sir Mirza's remarkable career had its origins in his association with Maharajah Krishnarajendra Wadiyar who was the Ruler of the State of Mysore for many years. Sir Mirza held various official positions from the year 1908 onwards which brought him into close personal contact with the Maharajah and enabled the latter to appreciate his great abilities. This led to his selection for the high office of Dewan in the year 1926. He held this position for over fifteen years, during which period the Mysore State achieved notable progress in many directions. Sir Mirza enjoyed the confidence of the Maharajah to the fullest extent and was therefore in a position to exercise the initiative and reforming zeal which were a marked feature of his activities in office. These activities covered many fields and were inspired by a deep interest in the welfare of the people. Sir Mirza's accessibility and personal charm, coupled with his breadth of understanding and his keen sense of human and cultural values made him a great and highly successful administrator.

We would like in the pages of *Current Science* to pay a special tribute to Sir Mirza's appreciation of scholarly achievements and to his understanding of the value of scientific research for the advancement of the country. These found eloquent expression in the admirable speech made by him at the Inaugural Meeting of the Indian Academy of Sciences held at Bangalore on the 31st of July 1934. In that address

he paid a tribute to the recent developments in the field of scientific research in India and referred to the successes achieved by it as "having been nothing short of spectacular" and as "brilliant discoveries which have done much to bring India to the forefront among the nations in the field of scientific advance". In that speech also, he welcomed the choice of Bangalore as

the home of the Indian Academy of Sciences and stated that "no more favourable ground than Bangalore could be found for the germination of the idea of an Indian Academy of Sciences and for the subsequent growth of the organism into a flourishing national institution with the necessary international affiliations".

Sir Mirza's address at the Inauguration of the Academy was followed up soon afterwards by the action taken by the Maharajah on his recommendation in making a gift in perpetuity to the Indian Academy of Sciences of the magnificent site of eleven acres of land on which the Academy itself, as well as the laboratories

of the Raman Research Institute and the office of *Current Science* are at present located. The Government of Mysore also sanctioned a substantial annual grant in aid of the publication of the *Proceedings* of the Academy. These *Proceedings* have continued to appear since the inauguration of the Academy in an unbroken sequence month after month on the due dates for the last twenty-four years. Men of science in India have therefore good reason to be grateful to Sir Mirza Ismail for his farsighted wisdom.

For many years, in fair weather as well as in foul, Sir Mirza Ismail remained the truest of friends to the writer of this notice, ever ready to give him support and advice when needed. He leaves behind him a memory which will be treasured and cherished by all who have known him.

C. V. RAMAN.



REFINING OF COTTON-SEED OIL

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COTTON is a major world crop and is the basis of a very large industry. Cotton-seed is produced as an important by-product. It is a useful oilseed capable of yielding a high percentage of good quality oil, but there has been serious difficulty in utilising it. This is due to the presence in the seed and in the raw oil of a toxic and colouring principle called gossypol and some related pigments. Consequently, it has not been fully used. Employing control methods at various stages and modern technological advances, the industry in U.S.A. has had considerable success. Still the success has been only partial and the cotton-seed oil has posed a problem which has defied complete solution for a considerable number of years.

Normally, the presence of colouring matters in oils is not objectionable because they are non-toxic and are sometimes useful, e.g., carotenoids. However, gossypol present in cotton-seed oil is not only toxic but can also get easily oxidised and produce a dark colour. Since it is a phenolic substance, it may be normally expected that alkali washing would remove it from the oil. This seems to happen to a limited extent when the quality of the seed and the efficiency of the processes are high. But in general various changes take place during storage of the seed and oil and during the alkali refining process; as a consequence, the colour gets fixed, in the sense that it cannot be removed by alkali treatment. Such oils deteriorate on storage and produce further colour even after processing. Treatment with bleaching earths does not remove the defect.

The position is particularly difficult when we consider cotton-seed oil as is usually available in India. Most of the crushing units are relatively small and do not employ good techniques of storing and crushing. They crush the seed even without delinting and dehulling (the hulls have recently been shown to contain leucodelphinidin¹). Consequently, the quality of the oil is very poor. It has become customary for the oil millers to give an alkali wash with a view to improve the colour and remove the free fatty acid. When this does not effectively reduce the colour, the oil is sometimes exposed to the sun for bleaching. It has been found during our investigations that these alkali washed or semi-refined oils, as they are called, are more difficult to refine than the crude oils. These oils

have been found to show marked fluorescence. For these reasons in spite of its abundant availability and good economic prospects, cotton-seed oil has not been popular with the vanaspati industry. Of the annual production of 1.7 million tons of seed barely 6% is crushed for purposes of oil, the rest being used mainly as cattle feed. The solution of the problem of cotton-seed oil purification lies in the complete removal of gossypol by a mild reagent which does not cause any complication. The use of caustic alkali brings about not only loss of oil, but also certain changes which are undesirable and which lead to colour fixation in several cases. The precise reason for this phenomenon is not quite clear. For the purpose of complete removal of gossypol, use has been made of its capacity to form oil insoluble Schiff bases with amines. Various derivatives of aniline were tested and the most satisfactory results have been obtained by the use of *p*-amino-benzoic-acid.² But this method cannot be used on an industrial scale since the reagent used to remove gossypol is comparatively costly.

For nearly 20 years, much interest has been shown on the chemistry of gossypol which is a beautiful golden yellow substance with unique chemical properties and structure. Considerable difficulty was experienced even in the isolation of pure gossypol in good yield. In recent work on flavonoids, a group of compounds which occur widely in the plant kingdom, aqueous borate solution has been found to be very useful for purposes of extraction and separation of the components. This is dependent on the presence of orthohydroxy carbonyl groups and catechol units in them. Since gossypol has in its molecule similar groups, the above method appeared to be applicable. It readily forms a water-soluble borate complex which is stable in alkaline solution and on acidification yields gossypol in good yield.³ An extension of the use of this discovery has provided a convenient method of purifying cotton-seed oil and cotton-seed cake and yields products free from this toxic and colouring principle. At the same time the gossypol present can be recovered fully as a by-product.

THE PRESENT METHOD

In our method, crude cotton-seed oil is agitated with an aqueous solution of sodium borate or borax with or without addition of extra alkali

to dissolve out gossypol and related pigments; some other impurities such as gums and phosphatides also separate out as amorphous precipitate. After these are removed alkali refining of the oil is done in order to remove free fatty acids and other impurities. Alternatively, alkali-refining could be done without prior separation of pigment-borate complexes. This method can be operated both as a batch process as well as continuous process. We have found that the procedure is very effective and removes the pigments completely as shown by ultra-violet absorption measurements. There was no colour reversion by keeping the treated oil samples at 39-40° for one month. The new method is also simple and highly economical in chemicals, labour and heating. Further, the soap stock obtained in our process is of much better quality and can easily be processed to yield good quality soap, while the soap stock that is obtained by the current practice is very dark in colour and fetches hardly any price. This further reduces the cost of refining.

Search for earlier patent literature has revealed that the use of boron derivatives was considered in the past. McNicoll¹ suggested the use of borax or magnesium borate in sufficient quantities along with boric acid or glycerine for the precipitation of gossypol from cotton-seed oil. He insisted on acidic conditions. Johnson² proposed the use of esters prepared from boric acid anhydride and glycerol for the same purpose. These seem to have been empirical

suggestions with no clear idea of the structure of gossypol and the reactions involved. They have not been obviously useful and have not been mentioned in treatises on cotton-seed oil (Bailey, *Cotton-seed and Cotton-seed Products*, Interscience Publishers, Inc., New York, 1948). The use of glycerine and boric acid actually stops the reaction of borax with gossypol (boric acid does not dissolve or precipitate gossypol and glycerine itself forms a water-soluble complex with borate solution) and the method becomes unworkable. The glycerol esters of boric acid anhydride are of no use in the removal of gossypol.

The new method is rational and efficient and has worked successfully in large-scale trials. One of its important features is the ready formation under mild alkaline conditions of gossypol-borate complex in preference to reaction with free fatty acids present in the oil. Consequently, the whole of the gossypol gets removed and very little of the free fatty acids is lost.

1. Kailash Chander and Seshadri, T. R., *J. Sci. and Industr. Res.*, 1957, **16 A**, 319.
2. Dechary, J. M., Kupperman, R. P., Thurber, F. H. and O'Connor, R. T., *J. Amer. Oil Chem. Soc.*, 1954, **31**, 420.
3. Kailash Chander and Seshadri, T. R., *J. Sci. and Industr. Res.*, 1958, **17 B**, 279.
4. *U.S.P.*, May 1928, **1**, 671, 834.
5. *B.P.*, Oct. 1932, 398, 405.

INDIAN AGRICULTURAL RESEARCH INSTITUTE—AGRICULTURAL UNIVERSITY

THE Indian Agricultural Research Institute has been conferred the status of a University which will confer on her students the Degrees of M.Sc. and Ph.D. in all the important subjects of Agricultural Science.

The decision of the Government of India to establish a Post-Graduate School at the Institute solely devoted to Post-Graduate teaching in the Agricultural Sciences, is a noteworthy event and will mark a new era in the annals of the agricultural research and education.

The Institute is locally and popularly known as the Pusa Institute, after the name of a small village called Pusa in Bihar where it was first established in 1905, with a munificent donation of \$ 30,000 by Mr. Henry Phipps, an American philanthropist. Since its foundation, the Institute has always symbolised the growth and development of agricultural research and education in India.

The present decision to provide at this Institute a full-fledged Post-Graduate School is but a natural step in crystallising the shape and in fulfilling the objects which the planners of the Institute had in view. The recommendations of the Indo-American Team on Agricultural Research and Education were instrumental in giving shape to the idealism of its founders. The Post-Graduate School which will mainly be responsible for carrying out the teaching programme has come into existence with the generous aid of the Rockefeller Foundation of the U.S.A. The aim is to train leaders who will dedicate themselves to the improvement of agricultural technology in India and who will have the competence, in the scientific disciplines concerned, to lead the programmes effectively.

Provision has been made, for the present, for admitting each year up to one hundred students for the M.Sc. Degree, and fifty students for the Ph.D. Degree.

FRACTIONATED X-RAY DOSE AND CHROMOSOME ABERRATIONS IN BARLEY

H. K. JAIN AND P. K. MUJUMDER

Indian Agricultural Research Institute, New Delhi

THE early experiments of Sax^{1,2} which showed that the yield of chromosome aberrations was greater at higher intensities of irradiation and which were interpreted as indicating that restitution and reunion of broken ends take place within a very short time of their occurrence, pointed the need for studying the effect of dose fractionation on chromosome breakage. Experiments of this nature by a number of investigators with *Tradescantia* as the experimental material have given conflicting results, leading to two opposite interpretations—one supporting the theory of immediate restitution and reunion, the other consistent with the conclusion that the breaks may remain open for 12 hours or more.

In the present study, barley root tips were irradiated with an X-ray dose of 2,400 r given continuously or divided into two equal fractions separated by 2, 4, 6 and 8 hours. The continuous dose or the first fraction of it was given to the root tips of seeds which had been kept for germination for 15 hours. Observations on the division cycle in the root tips had been made earlier and it had been determined that the cells, in the 15 hours sample, exist in resting stage and do not emerge from this condition, i.e., enter prophase until about 9 hours later. In this way it was ensured that both the continuous dose and

its variously separated fractions were given to cells in the same stage. In order to find out whether the sensitivity of the chromosome and other factors determining breakage yield vary during the course of the resting stage the continuous dose was also given to 17, 19, 21 and 23 hours old samples, thus covering the entire length of the resting stage over which the two fractions were spread. All the fixations were made 13 hours after the beginning of the first exposure, with the exception of the above four samples which were fixed after shorter periods as shown in Table I. The root-tips irradiated with the continuous or the variously fractionated dosages were treated with a 0.2% aqueous solution of colchicine for a period of 5 hours immediately before fixation in order to arrest the cells at metaphase for scoring the aberrations. The irradiation was done at an intensity of 2,400 r per minute at a distance of 15 cm.; the operating voltage being 50 kV. The germinating seeds before and after the treatment were kept at a constant temperature of $24 \pm 1^\circ \text{C}$. in a Cenco incubator. The Feulgen squash method coupled with counterstaining in aceto-carmin was used for making the preparations.

The aberrations recorded as chromosome reunions were the dicentric chromosomes and the centric rings; those recorded as breaks

TABLE I

Showing the frequencies of reunions and breaks due to (i) a 2,400 r continuous dose given at different periods of the resting stage, (ii) a single half-dose of 1,200 r, and (iii) the 2,400 r dose separated into two equal fractions

Interval between the fractions (hrs.)	Interval between fixation and		Chromosome reunions per 100 cells	Chromosome breaks per 100 cells
	First Exposure (hrs.)	Final exposure (hrs.)		
0	13	13	21.43 ± 2.258	98.57 ± 4.845
0	11	11	20.58 ± 2.100	94.95 ± 6.357
0	9	9	13.38 ± 2.295	98.03 ± 6.210
0	7	7	17.62 ± 2.516	94.24 ± 5.787
0	5	5	15.80 ± 2.361	93.66 ± 5.743
0 (s.h.d.)	13	13	4.65 ± 0.830	32.88 ± 2.22
2	13	11	6.15 ± 1.039	33.91 ± 2.441
4	13	9	11.42 ± 1.420	50.53 ± 3.003
6	13	7	14.67 ± 1.694	69.47 ± 3.686
8	13	5	14.93 ± 1.590	98.09 ± 4.127

C.D.
6.42

C.D.
16.11

the acentric fragments and the minutes. The chromatid aberrations were not taken into consideration because relatively few of them were produced with any of the treatments. Several hundred cells, without any selection, were analysed in each case for the scoring of the aberrations.

The observations in respect of each of the treatments are summarised in Table I. These show that when the radiation dose is given in two fractions with an interval of 2 hours between them, the frequencies of both types of aberrations are considerably reduced compared with those resulting from the continuous dose. When the interval between the fractions is extended to 4 hours, a reduction which however is less pronounced, can still be observed. As the gap between the fractions is still further increased, the aberrations frequency approaches more closely the breakage yield due to the continuous dose. The data thus show that the drop in the number of chromosome aberrations when the radiation dose is spread over two fractions with a relatively short interval between them is followed by a recovery which appears to reach a maximum for the reunion when the interval extends to 8 hours. Further, the aberration frequencies due to the single half dose of 1,200 r, also indicated in Table I, make it clear that the yield, on fractionation, drops below twice this value and rises above it, following the process of reduction and recovery.

A correct interpretation of results from investigations designed to study the dose fractionation effect, is rendered difficult because of the fact that radiation sensitivity of the chromosomes, as also the conditions determining restitution and reunion of breaks, are known to vary during the course of the nuclear cycle.³ The possibility that the changed frequency of the aberrations following fractionation of the dose might be due to the altered sensitivity or the different conditions for restitution and reunion in the two samples, has therefore to be taken into consideration. The observations in Table I show that neither the frequency of the reunions nor that of the chromosome breaks differ significantly when the continuous dose is given to cells at different stages of the resting condition, except in the case of the sample fixed 9 hours after irradiation, in which the frequency of reunions is slightly reduced. It is obvious that neither the extent of this reduction, nor the stage at which it occurs, suggest a possible change in the reduction-recovery trend of the dose fractionation data.

In view of these considerations, it may be supposed that the differences in the frequencies of the reunions and breaks due to the continuous and the fractionated dosages are primarily a function of dose fractionation.

The initial drop following fractionation of the dose as described here is in full agreement with the corresponding observations of Sax and Luippold,⁴ Lane⁵ and others^{6,7} on *Tradescantia*. Sax interpreted this drop as due to a possible property of the broken ends to reunite, reconstitute or heal within an hour, usually within a few minutes of the breakage and therefore failing to take part in reunions with those produced by the second fraction given after an interval of more than one hour.

Experimental observations opposed to this interpretation of the decline in the breakage yield were first described by Lane (*loc. cit.*). These showed that the initial drop was followed by a recovery as the interval between the fractions was extended beyond 4 hours. This recovery which is obviously not consistent with the theory of rapid reunion and restitution was not apparent in the experiments of Sax and a number of other authors. It has been suggested that the different conditions of experiments may be responsible for the contradictory results.

The present study in barley indicates a recovery in the frequency of aberrations similar to that reported for *Tradescantia*, although the two differ in their timings. The extent of this recovery suggests that the breaks due to first fraction remain open for reunion with those produced by the second, several hours later. Similarly the extent of the drop preceding the recovery is not fully explained by the hypothesis of rapid reunion and restitution. An alternative explanation of the dose fractionation results, however, is not very evident. Lane has suggested that the drop and recovery are due to a physiological effect of the radiation treatment, which makes the chromosomes temporarily less sensitive to subsequent irradiation.

We are grateful to Dr. B. P. Pal and Dr. S. M. Sikka for their kind interest and encouragement. Our thanks are also due to Dr. M. S. Swaminathan, for a discussion of the results.

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THE PROBLEM OF THE BLAST DISEASE OF RICE*

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DESPITE much work done on the blast disease of rice caused by *Piricularia oryzae* Cav. there is still a lacuna in our knowledge on the physiology of the fungus and its host-parasite relationships.

Our investigations and those of others indicate that the vitamins thiamine and biotin and the heavy metals Fe, Zn, Mn and, to a certain extent, Cu are indispensable for growth and sporulation of the fungus *in vitro*¹ and considerably greater amounts of the nutrillites are needed for sporulation than for growth.² Taking thiamine alone, the fungus does not need the intact molecule but only the pyrimidine fraction on a sucrose-nitrate medium. Curiously, however, the biosynthetic abilities of the organism towards thiamine seems to depend upon the nature of the substrate sugar. With maltose, pyrimidine is equivalent to the whole thiamine molecule, whereas with glucose as the carbon source, pyrimidine is not fully effective thus indicating that pyrimidine is probably active only when present with the labile γ form of glucose. The utilization of pyrimidine under these restricted conditions appears to be a temperature phase when disaccharides are hydrolysed.^{3,4} Inorganic nitrogen metabolism of the pathogen *in vitro*⁵ shows that while the fungus uses NO_3 nitrogen with ease, inorganic NH_4 nitrogen is not assimilated due to the development of a high physiological acidity in the case of ammonium salts of strong acids like ammonium sulphate. Should this acidity be neutralized with CaCO_3 or if certain organic acids of the Krebs cycle like succinic, fumaric and citric acids are added in small amounts, normal growth of the fungus is evident with ammoniacal nitrogen. Thus, the action of the organic acids appears to be two-fold: either they act as buffers or enter the metabolic cycle to combine with the ammonium ions to form the primary amino acids.

Among the metabolic products of interest synthesized by this fungus *in vitro* is the identification of the toxin piricularin and α -piconilic acid.⁶ What role thiamine and the specialized nitrogen sources this fungus seems to prefer play in the synthesis of these toxins

is a point of interest and offers great scope for future investigations.

Little is known of the biologies of parasitism of *Piricularia oryzae* and normal susceptibles fail to take infection under temperatures of 24–26° C. and above 95% humidity which have been found optimum for infection. Quite recently we have succeeded in demonstrating that a low night temperature (about 20° C.), is intimately connected with host susceptibility in altering the nitrogen metabolism of the host and favouring amide synthesis especially glutamine, by facilitating greater nitrate reduction.⁷ At high nycto-temperatures, nitrate reduction is possibly low and the photosynthates are mainly utilized in the building up of complex cell-wall materials which might combine with high concentrations of silicon observed in rice plants and form organo-silicon complexes which are relatively resistant to attack by extra-cellular enzymes of *P. oryzae*.⁸ Earlier results on the nitrogen metabolism of the rice plants, resistant and susceptible to the blast disease,² viewed in light of our recent findings indicate that the susceptible types possess a more keyed up enzyme system(s) for the efficient utilization of the absorbed N than the resistant ones. This appears to be true of glutamine synthesis in the two types.

Earlier investigations on the cuticular excretions of the rice plant in relation to disease incidence showed that a variety of amino and organic acids are found on the leaf blades of rice.⁹ Recent studies have, however, revealed that among the metabolites, glutamine crystallizes on the leaf surfaces in sizeable quantities under conditions of heavy nitrogenous manuring and markedly stimulates the germination of *Piricularia* spores.¹⁰

Current investigations on the resistance of rice to *Piricularia* indicate that resistance can be broken down with maleic hydrazide, but only if the plants have been subjected to a low nycto-temperature (20° C.).¹¹ This only strengthens our view that the resistance-susceptibility mechanisms in relation to the blast disease though primarily gene controlled, is intimately interrelated with the physiology of the host as influenced by the environment, particularly low nycto-temperatures.

All these experimental findings indicate exacting growth requirements of the fungus

* Summary of lecture delivered on the 29th December 1958, to the 24th Annual Session of the Indian Academy of Sciences, Baroda.

in vitro and possibly *in vivo*. It is, therefore, logical to consider the blast fungus as one with a higher level of specialization than a mere facultative saprophyte.

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A VERSATILE RESEARCH REACTOR WITH A NEW TYPE OF CORE

THE TRIGA, an American multi-purpose research reactor has been specially designed for research laboratories and academic institutions. It can be used for research and training, as well as for isotope production, and its makers, General Dynamics, claim that it is accident-proof.

The fuel elements consist of a solid mixture of uranium of 20% enrichment and zirconium-hydride moderators. Zirconium hydride is a remarkable substance because it has as much hydrogen per unit volume as water and at the same time has metallic properties.

The core is at the bottom of a well 20' deep and 6' in diameter. Shielding is provided by about 16' of water above the core, which gives sufficient protection from radiation and allows the removal of specimens while the reactor is operating. The water also allows the visual observation of the core and control rods during operation and provides a large volume of irradiation space.

Two safety rods and one regulating rod are used to control the power level and shut off the reactor. The driving mechanism for them is located on a steel grating at ground level.

A graphite reflector about 1' thick is provided on all sides and the bottom of the core.

It is sealed in a welded aluminium can to prevent water from entering the graphite. Six inches of graphite are also included in the top end of the fuel elements to provide a top reflector directly over the core.

Because of the inherent safety of the reactor, there is no need for an air-tight containment building.

TRIGA produces radio-isotopes of 62 of the first 82 elements and is particularly useful for making short-lived isotopes. There are many uses for these isotopes as in medicine where they can replace those with longer lives. For example, the 25-minute iodine-131 to lower the effective dose received by the patient for an equivalent amount of treatment. In industry, short-lived isotopes are valuable in process control.

Radiochemical work, including hot atom chemistry, can also be carried out with TRIGA.

According to the makers, TRIGA is capable of supporting a broad programme of teaching and research, including such subjects as reactor engineering, the study of isotope production and application, instrumentation through the use of isotopes, in addition to its wide range of medical and industrial applications. (*Atoms for Peace Digest*, Aug. 22, 1958.)

CHROMIUM "BULLETS" FOR CANCER

TINY "bullets" of radioactive chromium metal to fight against cancer are now available to medical science as a result of U.S. Bureau of Mines research in metallurgy.

The "bullets" are actually small metal cylinders, a tenth of an inch long and only a thirtieth of an inch in diameter, cut from strands of high-purity chromium wire. The wire is produced at the North-west Electro-development Laboratory of the Bureau of Mines in Albany, Oreg., with techniques developed by Bureau metallurgists.

Exposed to neutrons, some of the atoms in the chromium cylinder change to the radioactive isotope chromium 51. Tests indicated that chromium 51 offers many advantages over previously used radioactive "bullets" made from radiogold, radiocobalt or radiotantalum. Radiochromium is eminently suitable for permanent implantations in tissue for the treatment of cancer. The "bullet" can either be shot into the cancerous tissue by an "implantation gun", or they are sown into the malignant area.—*SASLO Science News Selections*—285,

LETTERS TO THE EDITOR

MAGNETIC ANISOTROPY OF
EUROPIUM SULPHATE OCTAHYDRATE
AND ASYMMETRY OF ITS CRYSTAL
FIELD

FRANK¹ has discussed theoretically the stark splitting of the energy levels of Eu^{++} ion in crystals under the influence of the crystalline electric field and its influence on the magnetic behaviour of the ion. She finds that a field of cubic symmetry in the neighbourhood of Eu^{++} ion gives a good fit with experimental mean effective magnetic moments between 83° K. to 343° K. as obtained by Selwood² and that the field of rhombic symmetry has very little effect.

It may be pointed out here that owing to the averaging out, the effect of the non-cubic part of the field, is not so conspicuous with crystal powder value, as it reveals only the effect of the cubic part. It is the measurements with single crystals that can reveal both cubic and non-cubic portions of the field. Hence we have recently measured the principal magnetic susceptibilities of single crystals of $\text{Eu}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ belonging to the monoclinic class with, most probably, 8 molecules in the unit cell.³

One direct consequence of a field of cubic symmetry would be a complete magnetic isotropy for the crystal and the observed deviation from isotropy would give us some idea of the deviation of the crystal field from cubic symmetry. Our measurements of $\Delta\chi$ by the method of Krishnan and Banerji⁴ and $\bar{\chi}$ by a quartz microbalance⁵ show that the magnetic anisotropy $\Delta\chi/\bar{\chi}$ is 0.126 ± 0.001 , where $\Delta\chi$ is the maximum anisotropy and $\bar{\chi}$ is the mean susceptibility.

This value of the magnetic anisotropy is not small. When we remember that group of atoms associated with each Eu^{++} ion in the crystal should have at least this anisotropy (in all probability, the anisotropy will be more as the different groups present in the unit cell of the crystal will not, in general, be oriented parallel to each other), and that it is the anisotropy of the above group—and not that of the crystal—which corresponds to the asymmetry of the field under consideration, it is easy to realize that the deviation from the cubic symmetry should be quite marked.

Details will be published elsewhere.

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THE CHARACTERISTIC NUCLEAR
SCATTERING OF 289 MeV. PROTONS

To correlate the experimental data on the nuclear scattering of 90 Mev. neutrons, Fernbach, Serber and Taylor¹ have introduced the optical model of the nucleus. In this model, a nucleus is represented by a sphere with a uniform distribution of nuclear matter characterised by a complex refractive index for the nucleon wave given by

$$n = 1 + \left(\frac{\bar{n}}{k}\right)\rho \quad (1)$$

where $\bar{n} = \bar{n}_1 + i\bar{n}_2$ and ρ is the nucleon density. It has been shown by Gatha, Shah and Patel² that the experimental angular distributions for the nuclear scattering of 340 Mev. protons by light elements can be reasonably represented by a characteristic angular distribution given by

$$|g(\bar{S})| = \frac{[\sigma(\bar{S})]^{1/2}}{2kA}$$

$$|g(\bar{S})| = \sum_{n=1}^3 a_n \exp.(-b_n \bar{S}^2) \quad (2)$$

where $\bar{S} = S \times A^{1/3}$ with $S = 2k \sin\left(\frac{\theta}{2}\right)$, while

$$a_1 = 0.01 \text{ mb}, \quad b_1 = 0.01 \times 10^{-26} \text{ cm}^2,$$

$$a_2 = 0.17 \text{ mb}, \quad b_2 = 0.07 \times 10^{-26} \text{ cm}^2,$$

$$a_3 = 1.03 \text{ mb}, \quad b_3 = 0.34 \times 10^{-26} \text{ cm}^2$$

Using the experimental differential scattering cross-sections of Bjorklund, Blandford and Fernbach³ for the nuclear scattering of 289 Mev. protons, $|g(\bar{S})|$ have been calculated for carbon and aluminium. The calculated $|g(\bar{S})|$ are plotted against \bar{S} for these elements in Fig. 1,

The theoretical $|g(\bar{S})|$ calculated from equation (2) is also plotted in Fig. 1. It is interesting to observe that the same characteristic

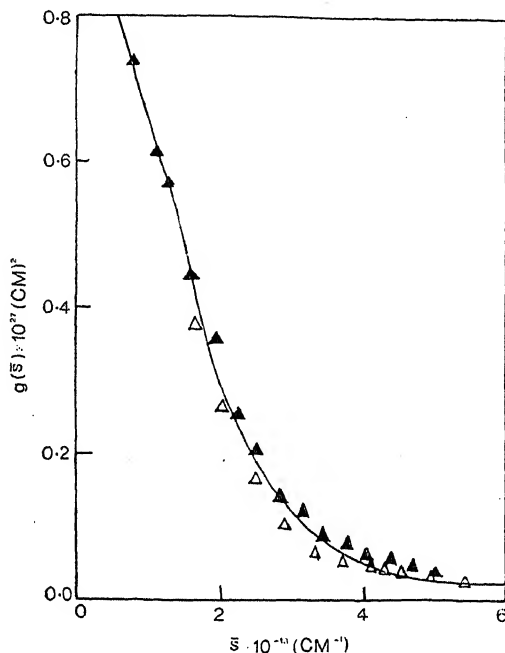


FIG. 1. The characteristic angular distribution for the nuclear scattering of 340 Mev. protons. Closed triangles and open triangles represent the calculated $|g(\bar{S})|$ for Carbon and Aluminium at 298 Mev.

angular distribution exists even at this energy. This strengthens the original assumption that there exists a characteristic nuclear density distribution for light elements.

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SODIUM METAPERIODATE OXIDATION OF STARCHES

OXIDATION with periodate ion resulting in 1, 2-glycol scission, is one of the most widely used reactions in carbohydrate chemistry. Since its discovery by Malaprade in 1928, the use of the reaction has been made in the field

of organic chemistry. Later on Jackson and Hudson¹ used this reaction for the structural studies of starch. Different workers^{2,3} showed that there was greater tendency towards over oxidation at or above the temperature 20°C. Grangaard *et al.*² have recommended that pH 2.5 should be maintained during the period of oxidation.

Periodate oxidized starch may be useful as a polymeric material in itself or after modification. The percentage conversion of anhydrous glucose units can vary from 0-100. For 100% oxidation of starch, 1.05 moles of sodium metaperiodate per anhydrous glucose unit was used but for lesser degrees of oxidation only the theoretical amount of reagent was used. Neglecting any abnormal periodate reduction by the end units of amylose or reducing end groups of amylopectin, the reduction of the oxidant should be about 1.03 moles per anhydrous glucose unit of starch when the oxidation is carried out to completion.

In this work the starches have been oxidized for different periods by mild oxidant NaIO_4 at room temperature (27-28°) and their physico-chemical properties have been studied.

The oxidation of starch was carried out by NaIO_4 (2%) and the dialdehyde units were calculated according to the method of Fleury and Lange.⁴ Alkali-labile-value was determined according to the method of Schoch and Jensen.⁵ Viscosity measurement of the oxidized

TABLE I

Physico-chemical properties of periodate oxidized starches

Period for oxidation (hrs.)	Alkali-labile value	Dialdehyde units %	% Hydrolysed starch at optimum conditions	
			Malt- diastase	Pan- creatin
<i>Andropogon sorghum</i> , Brot. (Jowar)				
1	..	42.0	26.1	..
3	..	50.0	31.5	..
8	..	56.0	43.0	..
13	..	67.2	61.0	..
18	..	71.5	87.3	..
22	..	78.8	102.2	18.9
<i>Phaseolus mungo</i> , Linn. (Math.)				
1	..	43.5	35.0	..
3	..	49.8	40.5	..
8	..	55.6	55.0	..
13	..	63.0	70.0	..
18	..	70.2	88.0	..
22	..	79.5	102.3	18.9

samples was done in 1 N KOH at 30° C. with the help of Ostwald's viscometer.

From Table I it can be marked that the oxidation of starches increases with the increase in the period of oxidation. It was completed at 22 hours' period.

Table II furnishes the data of physico-chemical properties of different starches oxidized by

observed that the digestibility of oxidized starches has been decreased.

Table III gives the data of physico-chemical properties of the untreated starches.

Authors' thanks are due to Prof. J. G. Choh for his interest in the work, and Shri P. Shah for the help in the work.

TABLE II
Physico-chemical properties of periodate and hypochlorite oxidized starches
(Oxidized at optimum conditions)

Name of starch	Viscosity (η)	Alkali-labile value		Oxidation		% Hydrolyzed starch at optimum conditions			
						(Malt-diastase)		(Pancreatin)	
		(a)	(b)	(a)*	(b)†	(a)	(b)	(a)	(b)
<i>Pennisetum typhoid-eum</i> , Rich.	1.010	80.8	18.4	102.2	268.8	18.7	25.3	23.5	27.0
<i>Panicum miliaceum</i> , Linn.	0.935	85.6	20.0	100.2	281.6	19.2	23.5	23.9	27.0
<i>Cicer arietinum</i> , Linn.	1.130	75.2	15.0	100.3	300.5	18.7	20.5	23.5	23.0
<i>Phaseolus aconitifolius</i> , Jacquin.	1.030	78.3	15.3	101.5	295.0	19.5	21.5	23.9	23.0

(a) Are the results obtained for sodium metaperiodate oxidized starches.

(b) Are the results obtained for sodium hypochlorite oxidized starches.

(a)* Dialdehyde units.

(b)† Oxygen uptake in milligram by 100 g. of starch.

TABLE III

Name of starch	Viscosity (η) in 1 N KOH	Alkali-labile value	% Hydrolyzable starch	
			Malt-diastase	Pancreatin
<i>Pennisetum typhoid-eum</i> , Rich.	..	1.542	29.9	30.2
<i>Panicum miliaceum</i> , Linn.	..	1.290	30.4	31.8
<i>Cicer arietinum</i> , Linn.	..	1.575	28.2	33.0
<i>Phaseolus aconitifolius</i> , Jacquin.	..	2.200	30.9	32.4

NaIO₄ and NaOCl. The values denoted by (a) and (b) are of NaIO₄ and NaOCl oxidized starches respectively. These samples have been used for the studies of their physico-chemical properties. The alkali-labile values of NaIO₄ oxidized samples are higher than those of NaOCl oxidized samples. From the viscosity measurements it is noted that there is decrease in the (η) due to the oxidation of starches. Digestibility of the oxidized starches has been studied with two enzymes, namely, (a) malt-diastase, and (b) pancreatin at 38° C. It is

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TRANSFERENCE NUMBERS OF ZINC
IODIDE IN DILUTE AQUEOUS
SOLUTIONS

THE earlier papers^{1,2} have presented data on transference numbers of some electrolytes in dilute aqueous solutions. This paper extends this investigation to include zinc iodide. Our present knowledge of the transference number of the zinc ion in zinc iodide solution is mainly due to Egan and Partington³ and Stokes and Levien⁴ by the Hittorf and E.M.F. methods respectively. The results are not in agreement. It was, therefore, considered reasonable to obtain independent data of the transference number of this bi-univalent electrolyte by the moving boundary method.

The mode of experimentation was the same as described previously.¹ The selection of the material for the electrode is of great importance. Gas must not be evolved at the cathode which is the closed side, since any volume change occurring there will affect the velocity and sharpness of the falling boundary. Preparation of non-gassing electrodes is also necessary in the Hittorf method.⁵

only at extreme dilution. In these experiments the transference numbers fall gradually between the concentration 0.01 N to 0.2990 N by only 15%.

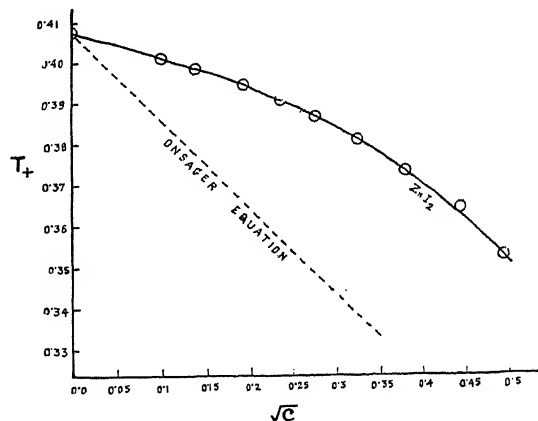


FIG. 1. The Onsager Limiting Slope: Comparison with Experimental Results in ZnI_2 .

It is considered that Hittorf method of finding transference number as adopted by Egan and Partington and Hittorf⁴ (1859) with this

TABLE I

Con. of ZnI_2 in gm. equi./litre (C)	\sqrt{C}	Constant Current	Con. of Indicator sol. NaCl	Transference Number of the cation 25° C.
0.005 N	0.07071	0.3 mA	0.0045 N	0.40944
0.01013 N	0.10064	0.3 mA	0.0095 N	0.39972
0.0202 N	0.14213	0.5 mA	0.018 N	0.39758
0.0402 N	0.20005	0.6 mA	0.0385 N	0.39444
0.06012 N	0.24497	0.8 mA	0.0570 N	0.39102
0.08110 N	0.28480	1.0 mA	0.080 N	0.38683
0.1132 N	0.33644	1.0 mA	0.110 N	0.38092
0.1501 N	0.38743	1.5 mA	0.150 N	0.37240
0.2031 N	0.45067	2.0 mA	0.200 N	0.36421
0.2453 N	0.49527	2.0 mA	0.250 N	0.35090
0.2990 N	0.54681	4.0 mA	0.300 N	0.34110

Fig. 1 represents graphically the data given in Table I. The transference number at zero concentration to which the curve in Fig. 1 has been extrapolated was deduced from the most recent published data⁶ available on limiting ionic conductances for zinc and iodide ions in water at 25° C. The transference number at infinite dilution for zinc ion in zinc iodide is, therefore,

$$T_{\text{zn}^{2+}} = \frac{\lambda_{+}^{\circ}}{\lambda_{+}^{\circ} + \lambda_{-}^{\circ}} = \frac{53.0}{53.0 + 76.8} = 0.40831.$$

Thus the value of the limiting slope derived from Onsager equation for zinc iodide is -0.21867 . The experimental curve in Fig. 1 merges into the limiting slope from above

electrolyte does not work satisfactorily in dilute solutions and give results which are outside the limit of error. Similar views have been expressed by other investigators.^{4,7,8} The results obtained by Stokes and Levien by E.M.F. method appears to be in agreement with the present investigation in dilute solution but could not be verified at higher concentration. The experimental curve obtained by Stokes and Levien for the transference number in zinc iodide is not smooth and has not been compared at low concentration with the Onsager limiting slope. The value of 0.410 for the limiting transference number assumed by Stokes and Levien is also slightly higher than the published data.

From thermodynamic studies, Bates⁹ has shown that zinc iodide is a normal electrolyte in aqueous solutions more dilute than 0.8 M. Stokes and Levien have also reported normal behaviour of this electrolyte below 1 M by their measurements of transference numbers and activity coefficients. These observations seem to be in accord with the results obtained in this investigation.

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THE PREPARATION OF URANIUM TETRAFLUORIDE

URANIUM tetrafluoride is generally prepared by the high temperature treatment of oxides of uranium with anhydrous HF¹ or Freons^{2,3} and secondly by the action of HF^{1,4} on the solutions of uranium (IV) salts, the reduction of uranium (VI) to uranium (IV) for the purpose being brought about by the use of SnCl₂. The present method has been to avoid high temperature treatment as well as the use of foreign substances in the preparation of the tetrafluoride. In this method uranium (IV) oxyformate prepared by the method of photolysis,⁵ as distinct from the method adopted by Rosenheim,⁶ formed the starting material. Thus the entire process of the preparation of the tetrafluoride is confined to uranium, formic acid and hydrofluoric acid.

When 30–40% HF (E. Merck G.R. quality) is added to finely powdered uranium (IV) oxyformate taken in a platinum crucible, uranium tetrafluoride is formed with evolution of heat. It was allowed to stand for an hour when the supernatant liquid was decanted off. The bright green precipitate obtained was next dried at 100° C. The analysis of the tetrafluoride was carried out by dissolving a weighed quantity of the substance in 8 N HCl, precipitating uranium as hydrated oxide with NH₄OH. The precipitate was filtered and washed. The

hydrated oxide was next heated in a platinum crucible to U₃O₈ and weighed, from which the molecular weight was computed. The filtrate was used for the estimation of fluorine as CaF₂.⁷ Uranium (IV) was also estimated by the method adopted by Hatt.⁸ The results of several determinations which yielded concurrent values showed that the compound prepared has the formula UF₄, 1.5 H₂O.

The preparation of the anhydrous tetrafluoride was next attempted by heating the compound at 150–60° C. in vacuum. The analysis of the compound obtained after heating for three to four hours indicated slight decomposition.

As mentioned above, the reaction of HF with uranium (IV) oxy-formate is an exothermic one. Our next attempt, therefore, is to utilise the exothermicity of the reaction in preparing anhydrous tetrafluoride at comparatively low temperature by treating anhydrous uranium (IV) oxy-formate with anhydrous hydrofluoric acid or freons.

The photolytic preparation of the compound will be published elsewhere.

Department of Chemistry, BALARAM SAHOO.
Ravenshaw College, D. PATNAIK.
Cuttack,
August 20, 1958.

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DETERMINATION OF ASCORBIC ACID (VITAMIN C) BY BROMATE-AN AMPEROMETRIC METHOD

RECENTLY we have shown¹ that micro- and milligram quantities of hydrazine can be estimated by direct titration with standard potassium bromate. The end-point is detected amperometrically using a rotated platinum microelectrode. Preliminary experiments revealed that the bromate method can be suitably adopted for the estimation of ascorbic acid (Vitamin C).

$\text{HBrO}_3 + \text{C}_6\text{H}_8\text{O}_6 + 4\text{H}^+ \rightarrow \text{HBr} + \text{C}_6\text{H}_6\text{O}_6 + 3\text{H}_2\text{O}$
In the usual procedure, p-ethoxychrysoidine is

used as a reversible indicator but when titrating dilute solutions of ascorbic acid, the indicator error becomes considerably greater and the sensitivity appreciably low.² Under these circumstances, amperometric end-point is ideal as it is independent of visual colour changes. Using a sensitive galvanometer (0-20 micro-amperes), an applied e.m.f. of zero (*versus* S.C.E.), and a rotating platinum electrode, direct titration of ascorbic acid with standard bromate was found feasible in solutions 2.0 N in hydrochloric acid and 0.05 M in potassium bromide. The diffusion current, almost zero in the beginning, increases linearly with the increments of reagent added after the equivalence point. A reversed L-type of graph is obtained and the intersection of the two straight lines corresponds to the precise end-point. It is possible to estimate accurately quantities of ascorbic acid as low as 0.1 mg. per 100 ml. of the solution. A detailed investigation on the ascorbic acid-bromate reaction in different acid environments, at various applied potentials and by varying other experimental factors is now being carried out and the results will be published at a later stage.

Our sincere thanks are due to Dr. Philip W. West, Boyd Professor of Chemistry, for research facilities and interest in the work.

Coates Chem. Labs., BHARAT R. SANT.*
Louisiana State ANIL K. MUKHERJI.*
University,
Baton Rouge, 3, La., U.S.A.,
August 20, 1958.

* Assistant Professors (Visiting) at Louisiana State University.

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COLOURED BARYTES FROM KHAMMAM (ANDHRA STATE)

COLOURED barytes have not been thoroughly studied with reference to the origin of their colours. Recently, while we were conducting a geochemical survey of barium-bearing belt lying at a distance of about 8 miles to the east of Khammam Town we noticed the presence of black, grey, green and dark-brown barytes amidst large deposits of the usual off-colour barytes.

The colour of the off-colour barytes which is mostly cream or light-brown is due to iron and is largely due to surface coating. But the

case of other coloured barytes is entirely different. They present interesting facts showing that the colour is due to the presence of elements like lead, copper, chromium and carbon.

It has been conclusively established both by physical and chemical examination that in most cases the colour of the black and grey barytes is due to the presence of finely distributed particles of galena (PbS). In some, carbon was also present along with galena contributing partly to the black and grey colour of barytes. In these barytes the lead content normally varies from 0.3 to 1% and sometimes even upto 3%. Presence of lead as galena was also noticed at a number of points in the barytes deposits as veins and as segregations. Work is now in progress to establish the cause of colour of green and dark-brown barytes.

Essen & Co.,
Bangalore-3,
October 11, 1958.

N. JAYARAMAN,
M. R. G. SHARMA.

ANISOTROPY IN BEDDED LIMESTONES

LABORATORY measurements of elastic constants of rocks are based on the assumption that rocks which are in the nature of polycrystalline aggregates are isotropic for such purposes. Zisman,¹ Idel,² Birch and Bancroft³ and Prasadara⁴ studied the directional variation of velocities of sound in several rocks and came to discordant conclusions. The author⁵ has studied the behaviour of rocks and came to the conclusion that most rocks, with no evident bedding or variation of composition, are nearly isotropic. Because of the stratified nature of limestones, it is thought desirable to study the variation of ultrasonic velocities in two directions, namely, (a) perpendicular to the bedding plane working with a section taken parallel to the bedding plane and (b) along the bedding plane working with a section taken perpendicular to the bedding plane. In the present investigation six bedded limestones from Shahbad quarries have been taken and ultrasonic velocities (both longitudinal V_L and torsional V_T) have been measured using the pulse technique as described by Krishnamurthi and Balakrishna.⁶ Below are given the velocities in m./sec. in sections (a) and (b) cut from different limestones. These velocities are further verified by the Wedge method.⁷

The results suggest that the velocities in the two directions differ appreciably. This is understandable in stratified rock like bedded

TABLE I

	<i>a</i>		<i>b</i>	
	V _L	V _T	V _L	V _T
1	7370	3260	6590	3090
2	6580	3340	6180	3250
3	6260	3140	5890	2940
4	6430	3320	6090	3080
5	6850	3290	6530	3160
6	7010	3420	6780	3260

limestone because of varying stresses acting in the two directions. McCollum and Snell⁸ made a similar observation working with stratified formations. The asymmetry observed by them is in accordance with that noted in the present work. Further it appears that many of the departures from isotropy observed at atmospheric pressure are due to differences of compactness in different directions and these are likely to disappear at high pressures.

Geology Department, S. BALAKRISHNA.
Osmania University,
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THE RARE R_y CHROMOSOME IN TWO PARSI FAMILIES

Soon after the discovery of the original Rh antigen (D) by Landsteiner & Wiener (1940), several workers made observations about newer and different forms of Rh antibodies and antigens. According to the theory of Fisher (1944), the Rh blood groups depend on three very closely linked loci on a pair of chromosomes which were called the C, D and E loci. Fisher & Race (1946) observed that by the combination of six alleles, viz., C, c, D, d, E and e, there would be eight possible types of Rh chromosomes. Of these, seven types were already detected then, but the R_y (CdE) chromosome was only theoretically postulated, with a frequency probably not more than 0.005. It

was van den Bosch (1948) who reported for the first time the Rh genotype $R_{y,r}$ (CdE/cde) in a Belgian family. Since then a few more cases of genotype $R_{y,r}$ have been reported in other countries.

Present Study.—About three hundred sibs belonging to 99 Parsi families were studied for various hereditary characters for the detection of autosomal linkage. Interestingly, the study of the Rh blood groups brought to notice two unrelated persons having the rare R_y chromosome. Both these persons were tested for the presence of the D antigen with a battery of incomplete anti-D sera, and were found to be negative.

It is essential to carry out a family study on the persons of phenotype CcdE in order to determine whether genotypically they are $R_{y,r}$ (CdE/cde), $R'R''$ (Cde/cdE) or R_yR'' (CdE/cdE), since all these genotypes give the same serological reactions with the usual four anti-sera (—C, —c, —D and —E). Family studies were therefore made on the two R_y cases reported herein. The anti-sera used for the serological tests were anti-C, —c, —D, —E and —e. The possibility of the propositi being of the genotype R_yR'' (CdE/cdE) was ruled out by the positive reaction with anti-e serum.

Family 1.—It became evident from the results obtained, that the propositus was $R_{y,r}$ (CdE/cde) and not $R'R''$ (Cde/cdE) as both the parents lacked the R' (Cde) chromosome. The father's genotype was revealed as R_yR_2 (CdE/cDE), he being homozygous EE and that of the mother as $R_{y,r}$ (cDE/cde), she being homozygous cc.

Family 2.—The propositus here also was $R_{y,r}$ and not $R'R''$. The father's genotype was revealed as $R_{y,r}$ (CDE/cde) and that of the mother as R_yR_1 (CdE/CDE), the R'' (cdE) chromosome being absent in the father who was homozygous ee and in the mother who was homozygous CC. The Rh genotypes in the two families are given in the italics (see Figs. 1 and 2).

FAMILY NO. 2

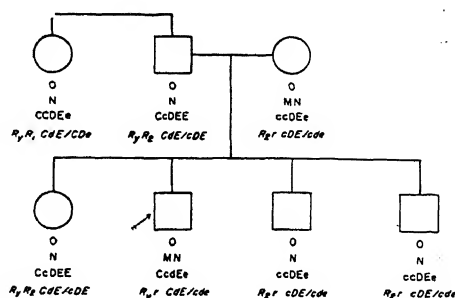


FIG. 1

Investigations of these two families showed that three members (paternal aunt, father and one sib) in family 1, and one member (mother)

FAMILY No. 2

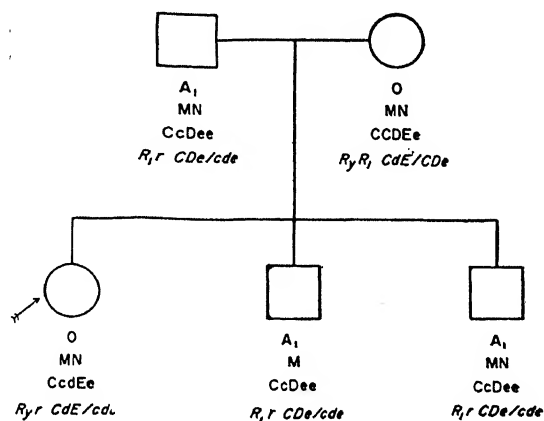


FIG. 2

in family 2 were the carriers of the R_y chromosome. But for the investigations on the proposition, the R_y chromosome would not have been detected in these persons by the serological tests with five anti-sera used in this investigation. Paternal aunt in family 1 and mother in family 2 would otherwise have been classified as $R_y R_1$ (CDE/CDE) which is also a rare genotype.

Occurrence of these two R_y cases leads us to believe that this rare chromosome may not be so uncommon in the Parsi community. Detailed results of the frequencies of various blood groups and other hereditary characters will be reported elsewhere.

Human Variation Unit, H. R. MASTER.
Indian Cancer Research Centre, H. M. BHATIA.
Parel, Bombay, L. D. SANGHVI.
August 2, 1958.

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STERILITY AND THE ASSOCIATED MORPHOLOGICAL CHANGES IN *CALLOSOBRUCHUS ANALIS* (F.) (BRUCHIDAE: COLEOPTERA)

A STERILE strain has been observed for the first time in the stored-grain pest, *Callosobruchus analis* (F.) in a culture jar containing heavily infested *Phaseolus radiatus* "Mung" grain. The normal males and females of such a population readily copulate but there are some apparently active but sterile individuals of both sexes which show a general aversion to copulate either with their own kind or with the normal individuals. These sterile individuals were isolated and kept in pairs (a male and a female) but could not be induced to copulate nor did the females lay any eggs. The isolated individuals, however, died after a time.

Certain colour and pattern changes of the elytra and pygidia are intimately associated with sterility. Sterile individuals of both sexes have a similar colour pattern of their elytra and pygidia and the sexes can hardly be distinguished from each other except by their antennæ and genitalia. The normal female has a black or dark brown pygidium with a mid-dorsal row of prominent white setæ (Fig. 1). Each female elytron (Fig. 2) is of a brownish hue and clothed all over with brown setæ except for a glabrous, more or less rectangular, dark area in the middle and a narrow dark strip along its posterior border, the former bounded anteriorly, mesially and posteriorly by a C-shaped band of white setæ. The normal males possess brown pygidia and elytra (Figs. 3 & 4), both covered with light brown setæ. The sterile individuals, on the other hand, possess pygidia (Fig. 5), resembling those of the normal males, and elytra (Fig. 6), resembling those of the normal females with the difference that the general coloration of the elytra and pygidia of the sterile caste is rather dull.

The sterile individuals, when dissected, exhibit the internal reproductive organs to be considerably reduced or poorly developed.

The cause of sterility and the time of the appearance of such sterile generations during the life-history of the individuals are being investigated. According to Wigglesworth (1950), a rise in temperature and a nutritional deficiency at the larval or adult stage affect the fertility in insects. It has been observed by us that *C. analis* normally lays one egg on each grain whereas in undisturbed air-tight jars, in which fresh grains are not added after the

first laying, the insect lays more eggs on the same grain with the result that more than one larva develop in any one grain but not more than one per grain reaches the imago stage and

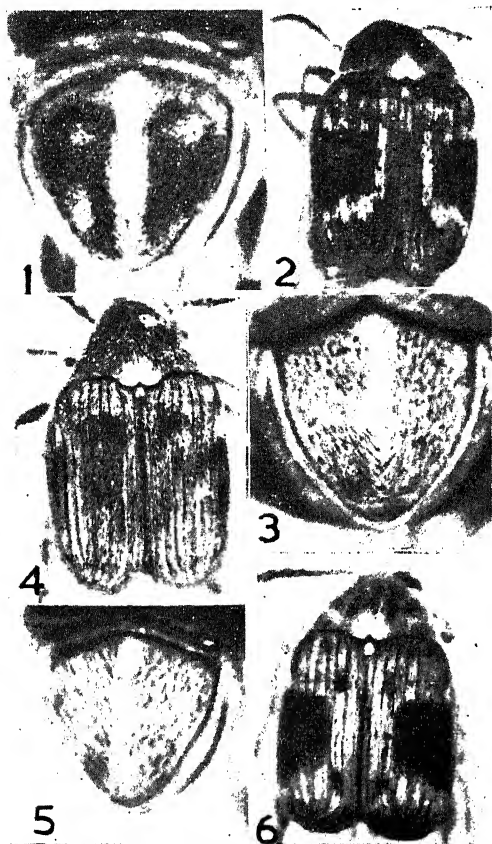


FIG. 1. Normal female (pygidium).
FIG. 2. Normal female (elytra).
FIG. 3. Normal male (pygidium).
FIG. 4. Normal male (elytra).
FIG. 5. Sterile individual, male or female (pygidium).
FIG. 6. Sterile individual, male or female (elytra).

the others die sooner or later. These developing larvæ do not remain inside the grain as they normally do but wriggle out of the grain and may either die or develop into sterile adults in which growth of the reproductive organs is arrested, leading to the peculiar inhibition for mating.

Dept. of Zoology,
Panjab University,
Hoshiarpur, June 17, 1958.

G. L. ARORA.
H. R. PAJNI.

THE PUPA OF *ALEUROTULUS* *MACULATA* (SINGH)

THE systematics of the Aleurodidæ are chiefly based on the detailed study of the pupa case and many workers in different countries (Bondar,¹ Corbett,² Singh,³ Takahashi,⁴ Russell,⁵ Menor⁶) have devoted their attention to the external details of the case. But little attention appears to have been paid to the contents of the case, namely, the pupa.

As pointed out by Imms,⁷ the family Aleurodidæ forms a link between insects with incomplete metamorphosis and those with complete metamorphosis, inasmuch as a pupal phase intervenes between the last larval instar and the adult. The larval cuticle of the 4th instar is retained as a covering to the pupa, which gradually separates from it. The pupa (Fig. 1) has a distinct head, the thoracic

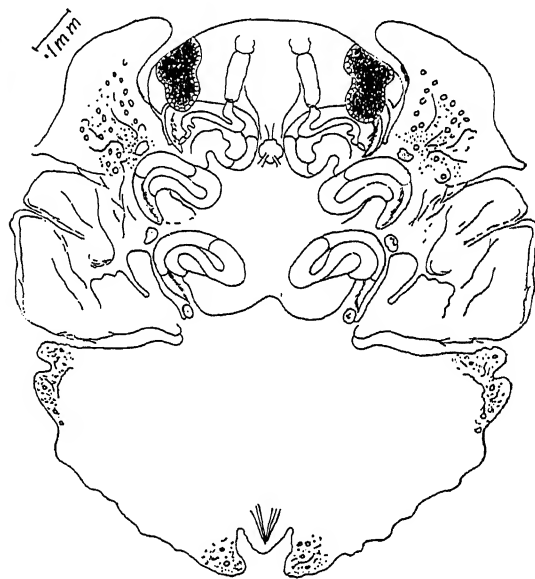


FIG. 1. Ventral view of female pupa of *Aleurotulus maculata* (Singh).

segments clearly indicated, but abdominal segments not demarcated from one another. It exhibits the various parts of the adult in a formative stage and for lack of space, the antennæ, the legs and the wings are seen in an elaborately folded condition. The wings like those of other Rhynchota appear to develop in an exopterygote fashion. The wing veins are faintly indicated. Since the wings are free from any secondary attachment to the body, the pupa may be regarded as of the exarate type. The compound eyes, constricted in the middle, are well developed and promi-

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nent, and are the first parts of the pupa to become pigmented. The mouth parts are mainly represented by the short tubular rostrum containing four minute stylets. The three pairs of spiracles, located in the thoracic region, are conspicuously seen. The developing fat body extends out in the form of a pair of outgrowths, in front of the wing pads, on the sides of the prothorax. It also extends laterally to the posterior end of the abdomen. It is gradually absorbed into the body with the growth of the pupa. These outgrowths are a prominent feature of the pupa of this species. Traces of the valves of the ovipositor are visible at the posterior end of the abdomen below the vasiform orifice. A full account of the pupal anatomy of this form will be published elsewhere.

Department of Zoology, KARAM SINGH.
College of Science, Raipur.
September 8, 1958.

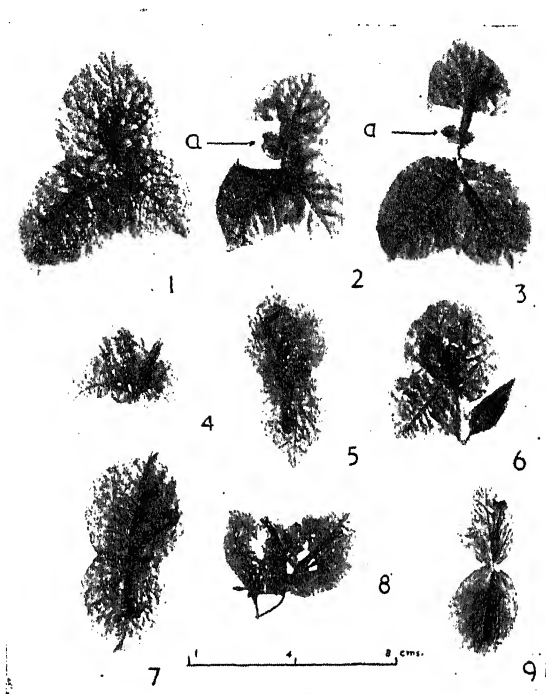
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SOME TERATOLOGICAL VARIATIONS IN THE INFLORESCENCES OF *BOUGAINVILLEA GLABRA* CHOISY.

NYCTAGINACEÆ is represented in India by the following three genera, (1) *Baerhaavia*, (2) *Mirabilis* and (3) *Bougainvillea*, teratological variations have been reported in all the three. In *Baerhaavia rependa* Willd., Singh and Sinha¹ observed the fasciation of vegetative leaves (one leaf homologue of two normal leaves). Similar observation was made by Singh² in *Mirabilis jalapa* Linn. also. In *Baerhaavia rependa* Joshi and Rao³ found that instead of two bracteoles, there are sometimes five bracteoles forming an involucre covering the perianth in the bud condition. In *Bougainvillea buttiana* Holttum and Standley, Marigowda⁴ observed the suppression of perianth resulting in a production of imperfect flowers. The variations found in a variety of *Bougainvillea glabra* Choisy. growing in Lucknow are recorded below.

1. The cymose inflorescence usually consists of three bracts, each bearing a flower in its axil (Fig. 1). In some inflorescences, however,

a fourth flower is found in the centre of the inflorescence, but without any bract attached to it (Fig. 4).



FIGS. 1-9. Fig. 1. A normal inflorescence. Figs. 2-3. Flowers with additional bracts; a, additional bract. Fig. 4. A four-flowered inflorescence. Figs. 5-9. Successive stages in the fasciation of two adjoining bracts resulting in the production of a biflowered cyme.

2. Usually there is one bract bearing one flower in its axil. But in certain inflorescences there are 1-2 additional under-developed bracts per flower (Figs. 2-3).

3. Two adjacent bracts of certain inflorescences have been found in all stages of fasciation (Figs. 5-9). In the first stage only the margins of two adjacent bracts one found partly fused, with distinct apices (Fig. 5). In the second stage the distinction of apices is lost, but that it is a fasciation product of two normal bracts is clear from its size, two mid-ribs, and two flowers borne on it (Fig. 6). In the third stage the midribs have also fused and the area of the fused bracts is further reduced. The two flowers borne on this bract (Fig. 7) indicate that it is a homologue of two normal bracts. In the fourth stage (Fig. 8) the "fused bracts" no longer bear two flowers, but it is still bigger than the other one. In the last stage the inflorescence is a biflowered cyme, hardly

retaining any sign of fusion of adjoining bracts (Fig. 9).

From the appearance of additional bracts per flower (Figs. 2-3) the question arises whether they are due to reappearance of phylogenetically lost parts, or they are new structures representing a forward trend towards multiplication in the number of bracts. In the light of the fact that in *Bougainvillea* practically no seeds are produced and that the sexual reproduction has been replaced by the vegetative, it is difficult to justify the idea of amplification in the floral parts. Thus it seems that these under-developed bracts are due to the reappearance of an ancestral feature; subsequently lost in the evolution of the inflorescence. That lost organs can sometimes reappear under conditions of cultivation is also known for the stamens of the 'female' flowers of *Ricinus communis* (Jain⁵).

The fasciation of adjoining bracts resulting in reduction in the number of bracts and flowers per inflorescence is definitely a forward trend, quite consistent with the replacement of sexual reproduction by vegetative reproduction both functionally as well as structurally.

My sincere thanks are due to Dr. R. N. Lakhanpal for very kindly going through the manuscript and offering valuable suggestions.

Birbal Sahni Institute of R. K. JAIN.

Palaeobotany,

Lucknow.

August 6, 1958.

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SOME OBSERVATIONS ON CONJUGATION IN *SIROCLADIUM KUMAOENSE* RANDHAWA

Sirocladium, a monotypic genus, was established by Randhawa¹ in 1941 from his algal collections of Almora District. The writer first came across this alga at Bhowali (Nainital District) in October 1956, and was subsequently found growing luxuriantly at several places in the vicinity of Nainital. It grows on damp soil in the form of dark-green patches and resembles certain terrestrial species of *Vaucheria* in external appearance. The alga was collected periodically during September-November 1957,

and was always examined in the living condition.

The present alga closely resembles *Sirocladium kumacense* in the morphology of the vegetative cells excepting slight variations in their cell measurements. Sexual reproduction, like *Sirocladium kumacense*, occurs predominantly by scalariform conjugation between two geniculate gametangia. Besides this, in some cases certain cells of one of the two conjugating filaments may also be found conjugating in a ladder-like fashion (Figs. 1, 2). In such cases

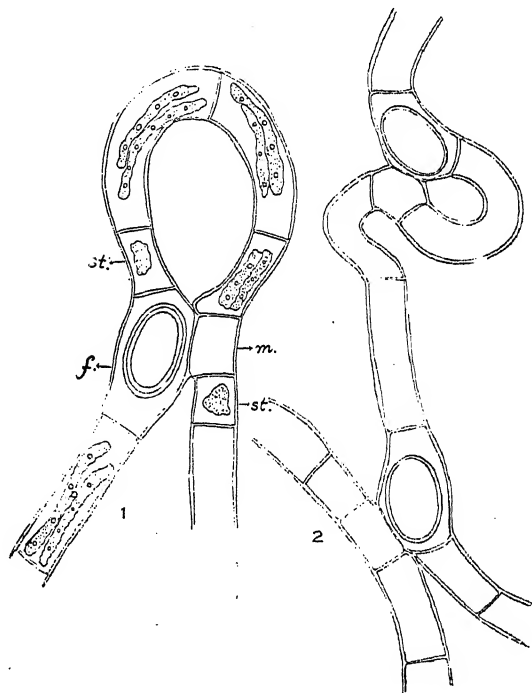


FIG. 1. Later stage in conjugation between certain cells of the same filament; sterile cells (st.) cut off from male (m) and female (f) cells. Note two-celled loop, $\times 141$.

FIG. 2. Scalariform conjugation between cells of two separate filaments and those of certain cells of the same filament. Note single-celled loop, $\times 141$.

it is interesting to note that the male and female gametangia conjugate after coiling round of the filament in the form of a loop (Figs. 1, 2). The loop may consist of one (Fig. 2) or several (Fig. 1) cells. The male and female gametangia in such cases are organized either by an unequal division of a vegetative cell (Fig. 1) or from a short undivided vegetative cell (Fig. 2). The zygospores formed in this case are ellipsoidal (Figs. 1, 2) and somewhat yellowish-brown in colour.

The present form has tentatively been identified as *Sirocladium kumacense* Randhawa.

The Nainital form, however, is of a special interest as it exhibits sexual conjugation between certain cells of the same filament, a phenomenon unrecorded so far in this genus.

Dept. of Botany,
"Th." D.S.B. Govt. College,
Nainital, U.P., July 29, 1958.

K. P. SINGH.

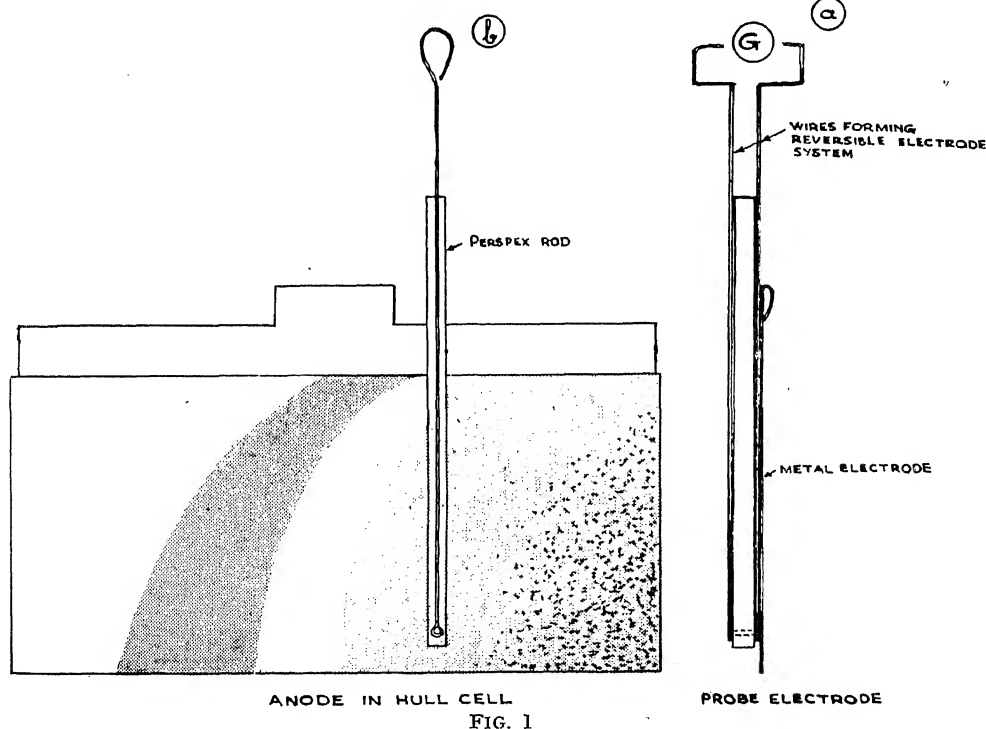
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A SIMPLE PROBE ELECTRODE FOR COMPARATIVE STUDY OF CURRENT DISTRIBUTION AT SURFACES

DURING our studies of electropolishing systems in a Hull cell,¹⁻³ which give rise to bands of different reflectivity and polish on different parts of the same inclined anode, we found that such sharp contrasts and discontinuities between bands could not be explained on the basis of potential variation, measured with a Luggin capillary, along the surface of the electrode.⁴ This clearly brought out the importance of

nature did not reveal any simple and ready method of studying the current distribution at different points on a given electrode during polarization. After some initial trials, a method has now been evolved and a probe electrode designed as follows:

A square cross-section (1/8" square) perspex rod of about 6" length is taken and its edges slightly rounded and smoothed. On one end of it a small hole (about 1/40" dia.) is drilled and on two opposite sides of the hole circular single loops of two wires, of the same metal as under study, or preferably any other metal forming reversible electrode system, are fitted and their ends are taken out along opposite facets of the rod (See Fig. 1). The wire leads are secured to the sides of the perspex rod with joining cement, e.g., "durofix" or quickfix' and then the whole assembly, excluding the hole and the wire loops across it, is well coated with an inert stopping off lacquer. This could be used as a probe electrode. When placed adjacent to the various parts of the electrode surface as shown in Fig. 1. by connecting the two wire leads to a sensitive low impedance galvano-



studying actual current distribution, which may vary greatly due to edge-effects and differences in thickness, nature, etc., of surface layers at polarized electrodes. A reference to the lite-

meter, the lines of force passing through that area converge to the wire loops and the galvanometer reading gives a comparison of the current densities in various regions of the

electrode. Although, a correlation of the observed measurements with the absolute current densities at various points is difficult and depends among other things on the thickness of wire, area of loops, their positioning and the distance between them, a comparison can easily be made and relative variation of current density plotted against distance from one end. This method has been successfully used by us in our Hull cell studies and has been found to be quite useful in explaining the banded structure produced in polishing of copper.⁵

Sincere thanks are due to Dr. K. S. G. Doss, Director, Central Electrochemical Research Institute, for many helpful suggestions and discussions.

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August 29, 1958.

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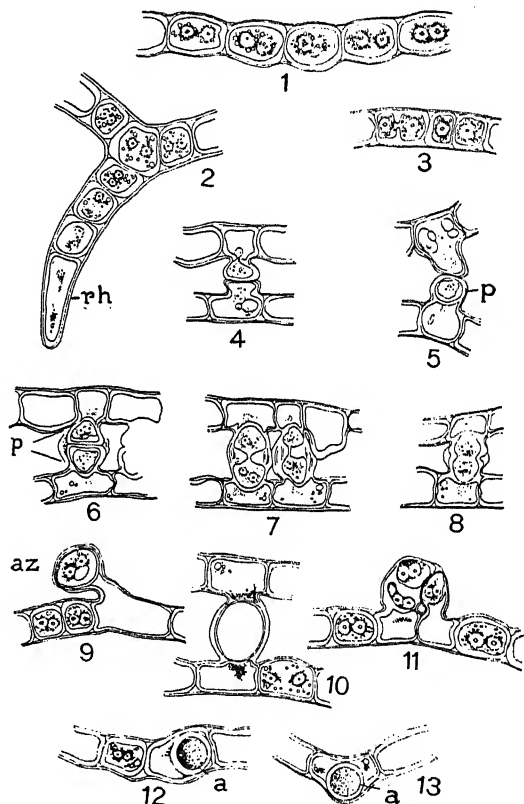
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REPRODUCTION IN ZYGOGONIUM ERICETORUM KUTZ.

THE object of this note is to record two collections of *Zygogonium ericetorum* Kutz. from India and to describe its reproduction. A sample of this alga was collected by Dr. Aiyappa growing on laterite soil on hill slopes and open ground at Makoot (altitude 4,500') in Coorg, Western Ghats, in Mysore State. Another sample of this material, mostly infertile, was collected by me from Nandi Hills, Mysore State, growing in the form of pale-yellow and whitish felt-like patches on the footpaths. The material from Coorg showed conjugation apart from akinete formation. Both the collections were made in the middle of August 1958.

The filaments are simple with one- to many-celled rhizoids (Fig. 2). The vegetative cells are cylindrical, 15.2 to 26.6 μ , broad and 15.2 to 67 (—100) μ long. The cell-wall is thick and colourless, and the chloroplasts are two rounded bodies with a single pyrenoid in each. The

cell sap is colourless. The cells are loaded with food material. Most of the cells were in akinete condition. In some cases, the akinetes appear barrel-shaped with thick walls (Fig. 1). In some cases, the cells divide into two by ingrowth of septa from the side-walls, and akinetes with a single chloroplast are formed as in *Zygnema terrestre* Randh. (Fig. 3).



FIGS. 1-13. Fig. 1. Barrel-shaped akinetes in a filament. Fig. 2. A filament showing a multicellular rhizoid. Fig. 3. A filament with akinetes with a single chloroplast. Figs. 4-8. Stages in conjugation. Figs. 9 & 11. Azygospores. Fig. 10. A ripe zygospor. Figs. 12 & 13. Aplanospores. a, aplanospore, az, azygospore, p, progamete ($\times 720$).

Conjugation.—The process of conjugation is very similar to that described by De Bary and Hodgetts. Progametes are formed from a portion of the protoplast. The progametes are cut off from the gametangia by ingrowth of cell-wall, leaving remnants of protoplasm in the gametangia (Figs. 4, 5 and 6). A pore is formed between the progametes and it enlarges resulting in the fusion of gametes and formation of a zygospor (Figs. 7 and 8) Zygospor. are ovoid, 15.2-26.6 μ broad and 26.6-30.4 μ long.

In this specimen all the distinctive features of conjugation in *Zyogonium ericetorum* are seen, e.g., formation of gametes only from a part of the protoplast, the remains of the protoplast in the gametangia, formation of walls which cut off gametes from the gametangia, and the peculiar method of fusion of the ends of papillæ.

Sometimes failure of conjugation takes place and azygospores are found at the tips of the conjugation tube attached to the gametangium (Fig. 9). Aplanospores which are rounded bodies, 15.2-22.8 μ in diameter, are also formed in the cells and cytoplasmic residue is clearly seen in the cell lumen outside the spore (Figs. 12 and 13).

This is the first record of *Zyogonium ericetorum* Kutz. from India and the mode of conjugation as described by Hodgetts in this species is also confirmed. Akinete formation of a new type is described.

Indian Council of M. S. RANDHAWA.
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THE UTILIZATION OF STARCH BY TWO SPECIES OF *PHYLLOSTICTA*

STARCH is the reserve carbohydrate in plants. Nearly all starches are composed of a mixture of two different kinds of polysaccharides, viz., amylose and amylopectins, both of which give D-glucose on complete hydrolysis. Generally the parasitic fungi convert starch of the host cell into glucose before utilization. This conversion is caused by *amylases* which cause splitting of the glycosidic bond in the polysaccharide unit.

Four types of changes are brought about in the culture medium during the disintegration of starch: (1) a decrease in the viscosity denoting cleavage in the polysaccharide chain, (2) loss in the capacity to give blue colour with iodine, (3) appearance of reducing groups, (4) formation of maltose, glucose and additional oligosaccharides of varying chain-length.

Single spore cultures of *Phyllosticta cycadina* (Pass) and *P. artocarpina* (Syed et Butl), were

inoculated daily in a culture medium (which contained 10 g. of starch, 3.5 g. of KNO_3 , 1.75 g. of KH_2PO_4 , 0.75 g. of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, and distilled water 1 litre). The filtrate of each day was analysed chromatographically by the method described by Giri (1952). *n*-Butyl-alcohol-acetic acid and water (4:1:5) was used as developing solvent, while aniline diphenyl amine phosphoric acid (5 vols. of 4% aniline, 5 vols. of 4% diphenyl amine and 1 vol. of phosphoric acid) served as spray reagent.

The results showed that during the growth of these organisms, the starch was not only converted into maltose R_f 0.55 and glucose R_f 0.68 (the normal hydrolytic products of starch), but three other oligosaccharides (R_f 0.45, 0.37 and 0.3 respectively) also appeared in the culture medium (*vide* Fig. 1, bands III, IV and V respectively).

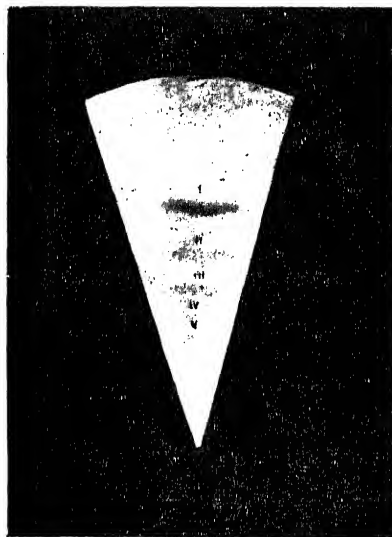


FIG. 1. Chromatogram showing the formation of glucose (Band I), maltose (Band II) and 3 oligosaccharides (Bands III, IV and V) during the growth of *P. cycadina* in the culture medium containing starch.

Hopkins (1946) classified the *amylases* into two broad groups, viz., α and β *amylases*. According to Hopkins the β *amylases* rapidly hydrolyse the amylose fraction of starch to maltose. This conversion is practically quantitative and only negligible amounts of oligosaccharides are formed. In contrast to β *amylases* the α *amylases* cause a rapid loss in the capacity of amylose to give blue colour with iodine and the rate of appearance of maltose is very slow. This indicates that in the present case the α *amylases* attack the interior chain of the glycosidic linkage and induce the formation of oligosaccharides.

The chromatograms clearly established that maltose was produced slowly in the culture medium. The results also established the formation of three synthetic oligosaccharides. Iodine test revealed that the growth of *P. cycadina* and *P. artocarpina* caused the disappearance of the starch of the culture medium on 3rd and 4th day respectively. These results further establish that these two species of *Phyllosticta* hydrolyse starch by α amylases.

Detailed investigations are in progress and the results will be published elsewhere.

The junior author is indebted to the authorities of National Institute of Sciences of India, for the award of a Research Fellowship.

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University of Allahabad. K. S. BILGRAMI.
August 14, 1958.

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COLOBODES DOLICHOTIS MARSHALL AS A PEST OF COWPEA

COWPEA (*Vigna catjang*) is an important pulse crop grown in South India. The writer, in the course of his studies on insects affecting this crop at Coimbatore, observed a good number of these plants grown at the Central Farm attached to Agricultural College and Research Institute, Coimbatore, wilting and drying. On examination, the stems of these plants were found badly riddled by the grubs of the weevil *Colobodes dolichotis* Marshall, and all stages of the weevil were noted inside the stem (Figs.

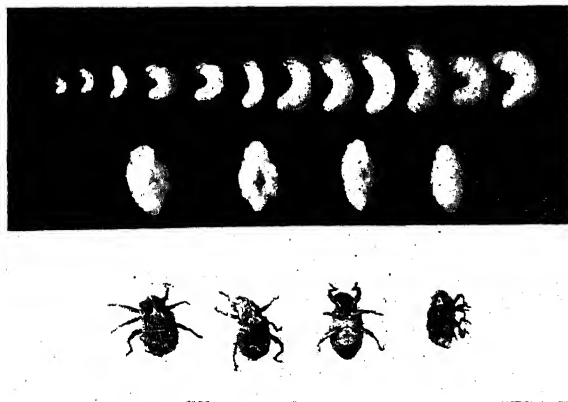


FIG. 1. Stages of *Colobodes dolichotis* M. 1 and 2). This weevil is a serious pest of *Dolichos lablab*, a common vegetable grown in

kitchen gardens, in which case the grub riddles the stem and causes the formation of huge galls



FIG. 2. Cowpea stem showing the damage by *C. dolichotis* M.

at the seat of injury. It has also been recorded on Redgram *Cajanus cajan* causing the same kind of injury at Coimbatore. The adult is a stout robust, dark brown beetle with a characteristic small V-shaped whitish mark on elytra, and measures about 8 mm. in length. The larva is a stout, fleshy white legless grub measuring 9 mm. in length, which riddles the tissues of the main stem and makes irregular galleries leaving plenty of frass behind as it bores onwards. Pupation takes place inside the stem and the pupa is white with prominent setigerous tubercles all over the body and measures about 8.2 mm. in length. The adult emerges by biting a hole at the sides. This is the first record of this weevil on this crop.

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August 12, 1958.

STRUCTURAL HYBRIDITY IN *ALLIUM* *OCHROLEUCUM*

Two bulbs of this species were received from Jardin Botanique, Mairie De Nantes, France, under the name *A. ericetorum* Thore. According to the Index Kewensis, the valid name of the species is *A. ochroleucum* Waldst. and Kir. The latter name has, therefore, been followed here. These bulbs were planted in pots and flowered last spring.

Nineteen chromosomes have been persistently counted in the root-tip cells (Fig. 1). Thirteen of these are metacentric (M), while the remaining 6 are telocentric (T). At metaphase the

centrameres of the telocentrics may be very minute and knob-like when undivided, or like 'horns of a snail' when divided (cf. Marks¹). No specific nucleolar constrictions could be made out.

Due to paucity of the material, the course of meiosis has not been followed in detail. However, metaphase-I is characterized by the presence of rings (Figs. 2, 3) and straight and

3 M, 2 M - T (Fig. 2), M - 2 T or 3 T. The bivalents may be composed of 2 M or 2 T (Figs. 2, 3) or M - T (Fig. 3). In the last case the bivalents are heteromorphic. At metaphase-I, the chiasmata are in general terminal, but in some cases the chiasmata may be interstitial. Darlington²⁻³ has observed similar interstitial chiasmata in *Tradescantia* and *Oenothera*. According to him "the presence

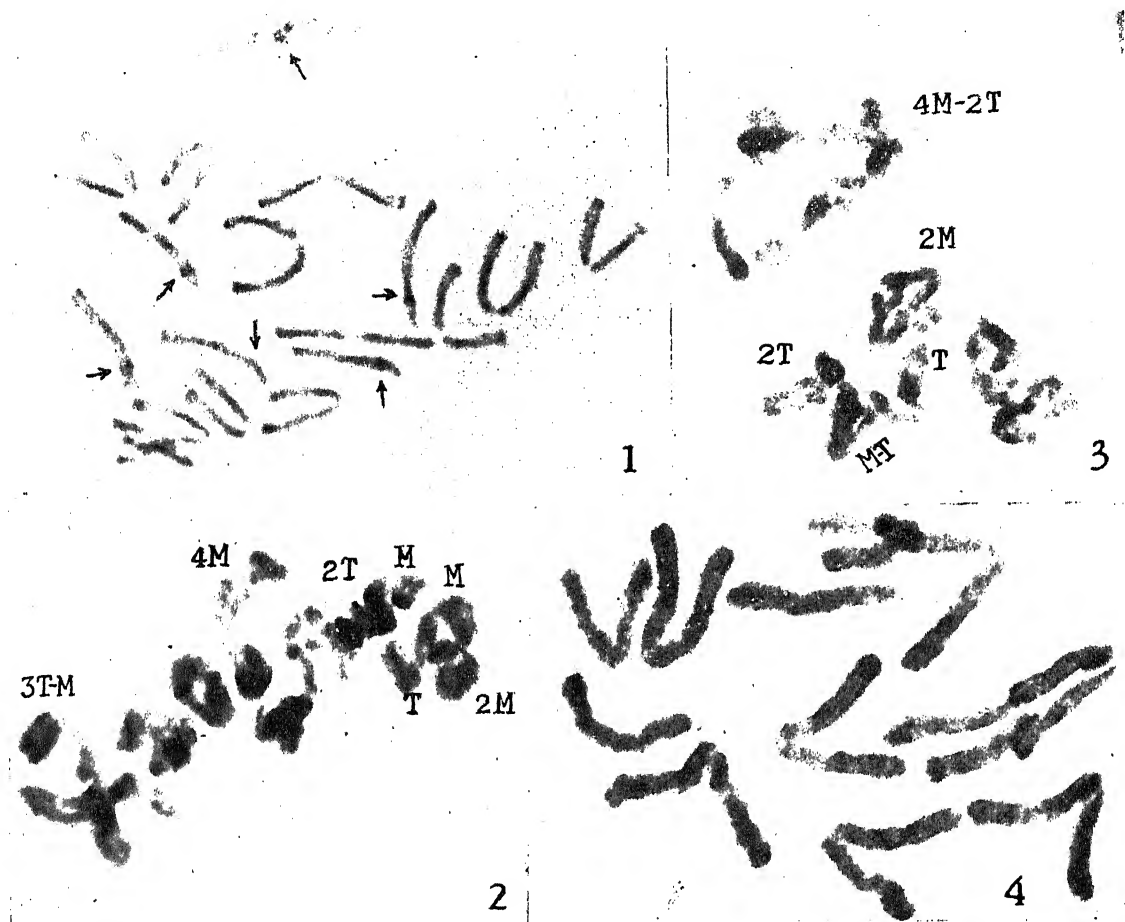


FIG. 1. Root-tip mitosis, $2n=19$ (13M+6T). Pretreated with 0.002 Mol. Soln. of 8-0 q, $\times 1,996$.

FIG. 2. Metaphase-I with 3 T-M+2 M+2 M+4 M+2 T+2 M-T+2 M, $\times 781$.

FIG. 3. Metaphase-I with 4 M-2 T+2 M+2 T+M-T+T+2 M+2 M. One association of 2 M's is not in the field, $\times 781$.

FIG. 4. One pole at anaphase-II with 12 chromosomes (10 M+2 T), $\times 1,562$.

zig-zag chains. These associations involve both metacentrics and telocentrics. The maximum number of chromosomes seen in an association is 6 which contained 4M - 2T (Fig. 3). The association of four chromosomes may contain 4M (Fig. 2), 3M - T or 3T - M (Fig. 2). The tripartite associations may be composed of

of a small non-homologous segment might offer a check to terminalization".

Anaphase-I was characterized by bridge-fragment configurations and at telophase-I, 0-3 micronuclei were found. Evidently, the present material is also heterozygous for inversions.

Nine different anaphase-II poles were exceptionally clear. Their analysis is given in Table I.

TABLE I

Chromosome Number	Karyotype	No. of Poles
19	16 M+3 T	1
18	16 M+2 T	1
12	10 M+2 T (Fig. 4)	1
	8 M+4 T	2
10	7 M+3 T	1
	6 M+4 T	1
9	7 M+2 T	1
	6 M+3 T	1

It looks probable that the poles with 18 or 19 chromosomes were the result of highly unequal segregation at anaphase-I, followed by failure of anaphase-II. Alternatively, these may be the products of stray tetraploid pollen-mother cells. The above table shows that the sexual progeny of this taxon is expected to be extremely heterogeneous karyotypically.

On analogy with an allied genus *Nothoscordum* (*N. fragrans*, Levan and Emsweller,⁴ Kurita⁵), it appears that the asymmetrical karyotype (13 M+6 T) of the present species has evolved from a perfectly symmetrical one, containing 16 metacentric chromosomes. The mechanism of evolution may be misdivision, resulting in the fragmentation of metacentric chromosomes across the centromere. In *Allium* somewhat comparable situation is found in *A. condensatum* (Sato⁶). This species has $2n = 17$ (15 M+2 T) and Sato advocates that out of the 16 original metacentric chromosomes, one has fragmented into 2 T. Same is also true of the karyotypes like $2n = 18$ (14 M+4 T) found by Levan⁷ in *A. pendulinum* and *zebdanense*.

With the present data on metaphase-I associations, it is not possible to conclude, if one chromosome each out of three different homologous pairs have fragmented, or if one complete homologous pair plus only one chromosome out of another homologous pair, have been involved in fragmentation.

The occurrence of rings and chains containing more than two chromosomes indicates clearly that extensive segmental interchanges have taken place. These have involved both metacentrics and telocentrics. Previously, besides *N. fragrans*,⁴ segmental interchanges have also been observed in two species of *Allium* namely, *A. ammophilum*⁷ and *A. scordoprasum* var. *viviparum*.⁸

This taxon is, therefore, a structural heterozygote and fragmentation, segmental interchanges

and inversions have been responsible for its evolution. It may be pointed out that these changes only result in a reorientation of the genic material, altering significantly both the original karyotype and the homology of the chromosomes.

The writers have harvested apparently well-filled seeds. These contain embryos within; however, their viability and cytology are being studied. The mechanism of seed formation is also under investigation. More important method, by which the taxon seems to have been preserved, is the efficient vegetative reproduction.

We are deeply grateful to Prof. P. N. Mehra for his helpful suggestions, to Mr. R. S. Pathania for the photomicrographs and to Dr. P. Plantiveau for sending the bulbs.

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August 18, 1958.

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AN IMPROVED METHOD OF TESTING THE LONGEVITY OF SPORES OF *TOLYPOSPORIUM PENICILLARIAE* BREF. IN SOIL

ABOUT $\frac{3}{4}$ square inch area on several clean slides was first smeared with juice from leaves of *Tradescantia tricolor* Hort.,¹ and dusted with smut spores collected during 1955-56, 1956-57 and 1957-58 (kept in the laboratory). After spores got fixed, several slides for each of the three years' samples were buried in November 1957 at 3, 6 and 9" depth. One slide from each treatment was taken out regularly at monthly intervals. The slides were gently washed with sterile distilled water to remove soil particles and allowed to dry. A drop of sterile distilled water was then placed on spores and incubated under moist condition for 48 hours at 24-28° C. and germination recorded.

The results obtained showed that irrespective of the year of collection, the germination of spores buried at 6" and 9" depth was excellent

until August 1958 (further tests are under progress), while that of spores buried at 3" depth was excellent only up to March 1958; (declining thereafter). It may be that high temperature after March in the upper 3" layer of soil is not favourable for spores.

The method described here for testing the longevity of spores in soil has distinct advantages, in that:—

(1) the spores are in direct contact with soil in the most natural conditions, (2) the method avoids complicated procedure and (3) testing of germination is simplified.

Detailed investigations are in progress and will be reported elsewhere.

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WILD RAMIE *BOEHMERIA PLATYPHYLLA* D.B. FROM WESTERN GHATS—A POSSIBLE SOURCE OF TEXTILE BAST FIBRE

Boehmeria platyphylla D.B. is a highly variable polymorphic species widely distributed in Western India, Africa and Pacific Islands.^{1,2} In view of its close taxonomic affinities with *B. nivea* cultivated for the industrial ramie fibre in Assam, China and Japan, *B. platyphylla* is being investigated in this laboratory. This

species has not received attention so far as a fibre source though a few other related species have been tried.³⁻⁴

From the polymorphic mixture of this species growing wild along western slopes near Mahabaleshwar (3,500 feet), stems, four to five feet long and about half to one inch girth, were dried and decorticated in raspador yielding about 10% crude fibre. It consists of fibre aggregates held together by pigmented resinous coat along with pieces of pith. The crude fibre was degummed by repeated boiling in 1% sodium hydroxide, bleached with sodium sulphite, neutralised with acid and repeatedly rinsed in water. Alternate biochemical methods are under trial. Yield of bleached fibre is about 5% on air dry stems.

Fibres are white lustrous with smooth silky feel. Individual fibres are fine, strong, 9 to 36 microns in diameter and consist of either flat twisted ribbons or hollow medulated tubes with nodal swellings, lateral projections, tapering ends and smooth or rough topography (see photomicrographs). Fibre length is highly variable due to mechanical conditions in raspador and therefore not mentioned for the present.

A small sample was sent to the Jute Technological Research Laboratory, Calcutta, and the following values given in Table 1 for *B. nivea* and *B. platyphylla* fibres have been communicated.

It is thus seen from the technological report of the above laboratory, that the fibres of *B. platyphylla* are inferior to those of *B. nivea*. However, these values relate to a specific sample derived from a mixture of botanical forms. In view of the botanical diversity in the polymorphic *B. platyphylla*, isolation of superior

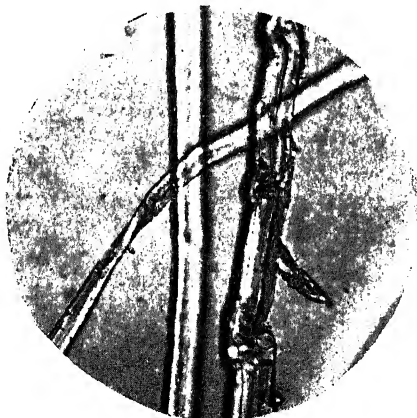


FIG. 1

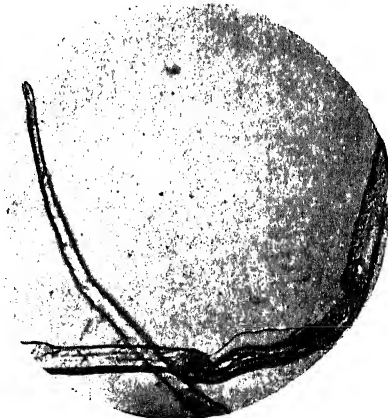


FIG. 2

TABLE I

Character	Mean Value	
	<i>B. nivea</i>	<i>B. Platyphylla</i>
1 Gravimetric measure (Mass per unit length)	8.49×10^{-6} gm./cm.	3.77×10^{-6} gm./cm.
2 Elliptical cross-section (on 150 filaments)	7.038×10^{-6} sq. cm.	4.186×10^{-6} sq. cm.
3 Flexural elastic modulus	..	11.7×10^{11} dynes/cm. ²
4 Breaking stress	74.7×10^8 dynes/cm. ² (approximately $65 \pm 5\%$ R. H.)	31.8×10^8 dynes/cm. ²

fibre types should be possible, with quality attributes approaching those of industrial ramie. A few such botanical types have been already isolated and are individually studied for their fibre properties.

A large number of seedlings as well as sets of *B. nivea* were planted at Mahabaleshwar during June and October 1952 but the plants from both these plantings perished during the following summer when subsoil moisture in porous laterite soils becomes scanty. Under the same conditions, however, *B. platyphylla* grows as a perennial and survives through summer dormancy. It can thus be cultivated as a purely rainfed perennial crop without any irrigation, on poor eroded hill slopes along contour ridges, giving one or two harvests of their stems during the monsoon and winter each year. It is intended to formulate suitable cultivation methods and work out the economic aspects.

Authors are deeply indebted to Dr. K. R. Sen of the Jute Technological Laboratory for his kind co-operation in fibre testing. Thanks are due to Prof. S. P. Agharkar for his keen interest and valuable discussion and to Shri S. G. Shende for certain facilities.

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EFFECTS OF SULPHANILAMIDE ON AN EARLY VARIETY OF RICE

AFTER the report of the effectiveness of sulphanilamide as a bacteriostatic agent,⁶ its effects have been studied on moulds (*Aspergillus* sp. yeasts,³ roots of *Lepidium sativum*,¹ *Pisum sativum*^{5,7} and *Lupinus* sp.,⁵ seeds,³ seedling and cuttings of higher plants.³ In the present investigation an attempt has been made to study the effects of sulphanilamide on the growth and flowering behaviour of an early variety of rice N. 136.

In Series I the treatment consisted of soaking the seeds for 48 hours in the aqueous solution of sulphanilamide at different concentrations of 1, 10, 100, 1000 parts per million (p.p.m.). In Series II in addition to this soaking treatment, plants were sprayed with the corresponding solution once a week starting with week-old seedlings till panicle emergence. Controls were soaked in water.

Higher concentrations of 100 and 1000 p.p.m. of sulphanilamide bring about a delay in ear emergence in both the series, more predominantly in Series II, while the lowest concentration of 1 p.p.m. brings about slight earliness. No change in flowering behaviour is seen with 10 p.p.m. (Table I).

TABLE I

Time from sowing to ear-emergence of main shoot in days

(Average of 16 plants. Sowing date—January 11, 1958)

Treatments	Days from sowing to ear-emergence			Earliness (+) or delay (-) in days
	Seed soaking (Series I)	Seed soaking plus spray (Series II)	Mean per treatment	
1 p.p.m. ..	70.00	70.00	70.00	+0.6
10 p.p.m. ..	70.19	72.19	71.19	-0.5
100 p.p.m. ..	71.94	74.06	73.00	-2.3
1000 p.p.m. ..	76.50	78.00	77.25	-6.5
Control ..	70.87	70.50	70.69	

Mean per series 71.90 72.95

S.E. Mean for chemical effect	= 0.23 and
do. C.D. at 5%	= 0.65
do. soaked and soaked plus spray	= 0.14 and
do. C.D. at 5%	= 0.41
do. interaction	= 0.32 and
do. C.D. at 5%	= 0.92

The production of tillers and leaves and elongation of the shoot in general is stimulated

TABLE II
Effect of sulphanilamide on tillers, leaves and plant height
(Mean value of both the series. Average of 16 plants in each series)

Treatments			Number of tillers per plant			Total number of green leaves per plant			Height per plant in cm.			
			15-2-58	2-3-58	17-3-58	15-2-58	2-3-58	17-3-58	15-2-58	2-3-58	17-3-58	
1 p.p.m.	..	..	2.03	3.97	3.75	6.78	17.09	12.75	25.66	46.60	60.50
10 p.p.m.	..	..	1.88	3.59	3.47	6.81	15.53	14.37	25.44	45.97	58.66
100 p.p.m.	..	..	1.56	3.63	3.66	5.59	15.16	13.69	23.47	44.56	57.98
1000 p.p.m.	..	..	1.00	3.00	3.16	3.44	11.59	11.28	18.50	39.48	52.21
Control	..	..	1.75	3.53	3.38	6.53	14.43	12.65	24.75	45.44	58.73
S.E. Mean			..	0.06	0.12	0.07	0.28	0.57	0.88	0.39	0.59	0.52
C.D. at 5%			..	0.18	0.35	0.21	0.79	1.63	2.54	1.13	1.71	1.50

in the plants treated with low concentrations of the drug whereas the highest concentration of 1000 p.p.m. produces significantly depressing effects in all these characters (Table II).

Thus the growth responses to sulphanilamide exhibit promotive effects at low concentrations and inhibitory effects at high concentrations.

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dium for penicillin fermentation in which the two usual nitrogenous raw materials, viz., cornsteep liquor and pea-nut meal are completely replaced by suitable quantity of waste mycelia.

The mycelial mass has been observed to serve well as the sole source of nitrogen without any treatment whatsoever except the usual sterilization along with other constituents of fermentation media.

Typical experiments carried out in shake flasks and 500 gal. stirred and aerated fermentor are presented in Tables I and II. The normal-

TABLE I
Shake flask fermentations

Hours of fermentation	Control (normal media)		Experimental (with mycelium)	
	Penicillin μ /ml.	pH	Penicillin μ /ml.	pH
72	1330	6.20	1290	6.20
96	2280	6.85	1970	6.50
120	2950	7.95	2800	7.10
144	2440	8.2	3040	7.5
168	Autolysis	..	3064	..
186	..	..	3000	8.05

TABLE II
Stirred and aerated fermentor (500 gal.)
(with mycelium)

Hours of fermentation	Penicillin μ /ml.	pH
41	900	6.8
49	1300	6.9
65	1900	6.9
89	2150	7.0
97	2350	7.0
120	2600	7.0

UTILIZATION OF WASTE MYCELIUM OF *PENICILLIUM CHRYSOGENUM* AS THE ONLY NITROGENOUS RAW MATERIAL IN PENICILLIN FERMENTATION

In a large penicillin factory a few tons of waste mycelium of *P. chrysogenum* are filtered off every day at the end of penicillin fermentation. The disposal of this waste product is an industrial problem. Proximate analysis of the mold waste obtained in this factory has shown a crude protein content of about 44% on a dry basis.¹

A vegetative inoculum of *P. chrysogenum* has been found to grow very well and produce penicillin at the normal rate in a standard me-

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fermentation medium contained lactose, corn-steep liquor, pea-nut meal and salts. In the medium containing mycelia, 20 parts of wet mycelia (dry matter 15-20%) were used in place of cornsteep liquor and pea-nut meal. A vegetative inoculum of a commercial strain of *P. chrysogenum* was used. All shake flask fermentations were carried out in duplicate at 24° C. in 100 ml. volume of media in 500 ml. shake flasks on a rotary shaker with 250 r.p.m. describing a circle of about 2" diameter. Phenyl acetamide, 0.1% was used initially as precursor. Penicillin fermentation in 500 gal. fermentor was made under commercial conditions using 0.1% phenyl acetamide initially and adding 0.05% phenyl acetic acid at 72 hrs.

Penicillin was estimated by a modified iodometric method² and occasionally checked by standard bioassay. pH was determined by glass electrode.

Use of waste mycelia as one of the principal raw materials for penicillin fermentation is a highly attractive proposition for a penicillin factory. The above results are clearly indicative of such possibilities. Experiments are in progress to determine the optimum conditions of fermentation with waste mycelia. Details will be published elsewhere.

The author is grateful to the Production Department for active co-operation and to Mr. B. N. Ganguli for technical assistance.

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ON THE OCCURRENCE OF THE METACERCARIAE OF *CLINOSTOMUM* SP. IN *TRICHOGASTER FASCIATUS*

THE metacercariae of *Clinostomum* Leidy have been commonly found under the skin and in the muscles of fishes and tadpole larvae of frogs. The adults usually occur in the buccal cavity and pharynx of fish-eating birds and reptiles.

These metacercariae have been reported from a number of Indian freshwater fishes by Bhalerao (1942) and B. L. Kaw (1950). So

far none has found them in *Trichogaster fasciatus* Bl. and Schn.

About 40 specimens of *Trichogaster fasciatus* obtained from various ponds in and around Patna were dissected and all of them were found to harbour this metacercaria. The average number of metacercariae found in a single fish was 6. They were found in the peritoneal cavity and a few in the branchial cavity. Most of the metacercariae were found adhering to the wall of the intestine by their well-developed ventral sucker. No encysted metacercaria was found in any fish. Attempts were made to find this metacercaria in other species of fishes inhabiting similar localities as *T. fasciatus*. Numerous specimens of about 25 species of fishes were dissected but none of these were found infected with this metacercaria.

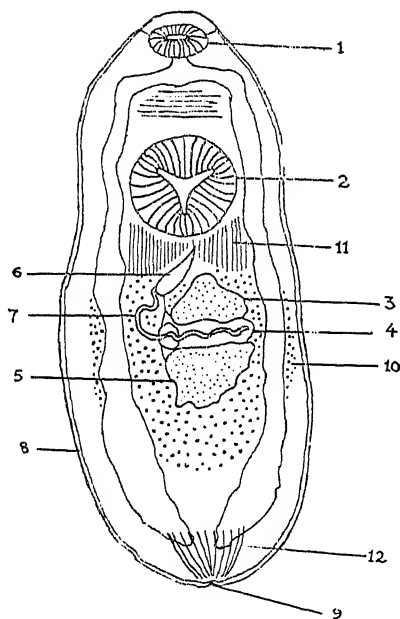
T. fasciatus, therefore, seems to be the normal intermediate fish host of the metacercaria of *Clinostomum*. This was confirmed by the universal occurrence of this parasite in *T. fasciatus* in Patna. In some of the fishes the infection was very heavy and in one specimen as many as 32 metacercariae were found. The fish hosts were apparently unaffected by the presence of these metacercariae.

Specimens of the metacercariae were fixed in Bouin's and Semichon's solutions and were stained in Ehrlich's Hæmatoxylin. The metacercaria has a flat and elongated body with a well-developed ventral sucker placed somewhat close to the oral sucker. The body is narrower in front of the ventral sucker than behind it. A short oesophagus is present which divides into two long and smooth intestinal caeca which reach nearly to the posterior tip of the body. A pharynx was not observed in any specimen. A network of excretory vessels was clearly seen specially in specimens obtained from the hosts starved for about 15 to 20 days. This was probably due to a tendency of accumulation of excretory wastes in such specimens. The rudiments of the gonads were present in the anterior half of the region behind the oral sucker. The ovary lies between the two testes. The rudiments of the vitelline glands are seen along the lateral region of the middle of the body. Traces of spines are present in the cuticular layer of the body-wall. The excretory pore is situated at the posterior tip. Some of the measurements of the metacercaria are given below in mm. :—

Length of the body	.. 2.025-4.856
Breadth of the body	.. 0.754-1.546
Diameter of the ventral sucker	.. 0.345-0.478

Transverse diameter of
the oral sucker ... 0.105-0.254
Longitudinal diameter of
the oral sucker ... 0.095-0.226

Attempts were also made to study the partially developed adult, after feeding the pigeons with the metacercariæ. In one attempt a pigeon was fed with 12 metacercariæ and after 72 hours of feeding 9 metacercariæ were recovered, of which 2 were inert. The metacercariæ were apparently digested by the pigeon when they remained in its body for more than 72 hours.



FIGS. 1-12: 1. Oral Sucker. 2. Ventral Sucker. 3. Anterior Testis. 4. Ovary. 5. Posterior Testis. 6. Cirrus Sac. 7. Uterus. 8. Cuticle. 9. Excretory Pore. 10. Vitelline Gland. 11. Part of Longitudinal Muscle. 12. Terminal part of Longitudinal Muscle.

Camera Lucida sketch of a metacercaria of *Clinostomum* sp. from *Trichogaster fasciatus*. (Stained with Ehrlich's Hæmatoxylin). Magnified approx. 50 times.

The partially developed adults were similar in disposition of the organs to the metacercariæ described above. The gonads, however, were more differentiated and showed a marked development. The testes were clearly seen consisting of two lobes placed anterior and posterior to the ovary. The cirrus and the cirrus-sac were seen anterior and to one side of the anterior testis. The ovary and the coil of the uterus were clearly seen. No ova were found in the uterus. The female opening and the terminal portion of the uterus were not clear.

No other development was detected. The intestinal cæca were smooth and unbranched, with an accumulation of food in the posterior blind end which was somewhat distended.

The author is indebted to Dr. Suresh Keshava, Professor of Zoology, University of Patna, for suggestions and laboratory facilities, and feels grateful to Dr. M. B. Lal, Professor of Zoology, University of Lucknow, for identification of the metacercaria and suggestions.

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FEMORAL SPINES AS A PHASE CHARACTER IN THE DESERT LOCUST

THE sensitivity of the hind-femur length as a phase character in the Desert Locust, *Schistocerca gregaria* (Forsk.), has been well established (Roonwal,¹ Roonwal and Nag,² and Misra, Nair and Roonwal³). Recently, Mukerji and Chatterjee⁴ stated that the spines or denticles on the upper (dorsal) edge of the hind-femur in *Locusta migratoria* Linn. from Southern India probably vary with the phase. We have studied this latter character in detail in *Schistocerca gregaria* and have established it to be a phase character.

Two types of hind-femoral spines are distinguishable, viz., (i) large, well-developed spines (height "A" or maximum straight-line height from tip to base, 0.037-0.111 mm.); and (ii) weakly developed spines (height "A", 0.009-0.055 mm.).

In individuals of the *solitaria* phase both types of spines, the well developed and the weak, are present in almost equal numbers. In the *gregaria* phase, on the other hand, only the weak spines are present. As regards the weak spines, while they show sexual differences within the same phase, there are generally little or no phase differences when comparisons are made within the same sex.

In the *solitaria* phase there are about 7-9 (mean 8) well developed spines and 6-11 (mean 8) weak spines, or a total of about 14-19 (mean 16) spines. No sexual difference is discernible in this respect. In the *gregaria* phase, where only weak spines are present, their number is about 18-22 (mean 20) in males and 17-21 (mean 18) in females,

The length of the spine-bearing area (a) was studied in relation to the total length of the hind-femur (b). In the *solitaria* males the ratio b/a is 0.428 ± 0.006 and this figure is significantly less than in females (0.469 ± 0.007). In the *gregaria* phase, however, the ratio in males (0.486 ± 0.007) is significantly higher than in females (0.453 ± 0.013).

Sexual dimorphism in respect of the size, etc., of the spines was also studied. It was found that the size is larger in females than in males.

Fuller results will be published elsewhere.

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ANOTHER CASE OF INTERACTION OF FACTORS IN *CICER ARIETINUM* L.

CHOUDHARY (1957) described two tiny-seeded segregates in *Cicer* having small-sized leaves and tiny pods containing small seed. The tiny pod and seed were observed to be recessive to the normal pod and seed of the 'Chafa'

variety (Kadam, 1945) and differed from it by a single pair of factors.

A similar *small-leaved* and tiny-seeded spontaneous mutant was spotted by the author (Argikar: unpublished) in a crop of 'Chafa' gram in 1948-49. In 1953-54, this new mutant was crossed with the *tiny-leaved* from (Ekbote, 1937; Choudhary and Argikar, 1957; Argikar, 1958), having tiny, clustered pinnules but normal-sized pods and seed. The seed, leaf and leaflet measurements of the two mutants used in the cross and of their F_1 hybrid are presented in Table I along with those of the normal type 'Chafa'. For the sake of convenience, the *tiny-leaved* form will be denoted as Mutant A and the *small-leaved* one as Mutant B in this note.

The F_1 hybrid of the cross between the two mutant forms had, therefore, *normal* leaves, leaflets and seed. The F_2 segregation observed for the leaf character is presented in Table II.

Since the fit for a digenic ratio is good, it is proposed to designate the Mutant A as $tlv\ tlv$ $smlv\ smlv$ and the Mutant B as $tlv\ tlv$ $Smlv\ Smlv$.

The F_3 frequencies and the genic symbolization of the types obtained are given in Table III.

The F_3 study confirms the F_2 findings. It will be seen that both the dominant genes tlv and $Smlv$ interact to produce *normal* leaf while tlv alone produces *small* leaf as found in Mutant B, $Smlv$ causing the leaf to be *tiny* as in Mutant A. The double recessive also produces *tiny* leaves.

TABLE I

Name of the type	Mean size of the seed in mm.		Mean leaf length in mm.	Size of the leaflet in mm.		Mean 100 grain weight in mg.
	Length	Width		Length	Width	
Mutant A ..	7.8	5.7	32.5	5.0	1.5	11.79
Mutant B ..	5.6	3.9	35.0	6.5	4.0	4.20
F_1 hybrid ..	7.9	5.8	40.0	8.5	5.0	12.00
Chafa (normal) ..	8.0	5.9	45.0	8.5	5.0	13.50

TABLE II

Name of the cross	No. of plants having			Total	X_2	P value
	Normal leaves	Small leaves	Tiny leaves			
Mutant A \times Mutant B ..	247	88	97	432	..	..
Reciprocal of the above ..	90	38	53	181	..	..
Total observed ..	337	126	150	613	..	..
Expected on a 9:3:4 ratio ..	344.80	114.94	153.26	613	1.59	0.20-0.30

TABLE III

F ₂ Phenotype	Genotype	No. of F ₃ progenies	F ₃ frequencies	Ratio	X ₂	P value
Normal-Leaved	Tlv Tlv Smlv Smlv	3	143 Normal-leaved plants	Breeding true	..	..
	Tlv Tlv Smlv smlv	8	272 Normal 178 Small-leaved	3:1 Fit not very good	..	..
	Tlv tlv Smlv Smlv	8	284 Normal 110 tiny-leaved	3:1	1.790	0.10-0.20
	Tlv tlv Smlv smlv	5	110 Normal 51 Small 53 tiny-leaved	9:3:4	4.070	0.10-0.20
			63 Small-leaved plants	Breeding true	..	..
Mutant B ..	Tlv Tlv smlv smlv	1	97 Small 33 tiny-leaved	3:1	0.033	0.95-0.50
Mutant A ..	tlv tlv Smlv Smlv	10	213 tiny-leaved plants	Breeding true	..	..
	tlv tlv Smlv smlv					
	tlv tlv smlv smlv					

Studies on the inheritance of the seed character in the above cross indicated that the normal seed was dominant to the tiny seed, the difference being monogenic. When the two characters, viz., the leaf and seed types are considered together in all the plants that bore seed, it is found that one of the two dominant factors that affect the leaf is also responsible for the production of normal seed; the same character in its recessive condition produces tiny seed. From the recombinations obtained for the leaf and seed characters as are presented in Table IV, it will be observed that the factor

Smlv causes the seed to be of normal size while smlv governs the *tiny* size, the factor Tlv having no effect on the seed character.

The *normal* leaf in *Cicer* could, therefore, be now designated as Slv Slv Tlv Tlv Nlv Nlv Glv Glv Alv Alv Smlv Smlv comprising of at least six pairs of factors in continuation of the five already mentioned (Argikar, 1958).

The author is grateful to Dr. R. D'Cruz for his kind help in scrutinising this note.

Bombay Agric. Dept.,
Poona, September 10, 1958.

G. P. ARGIKAR.

TABLE IV

	Normal-leaved normal-seeded	Small-leaved tiny-seeded	Tiny-leaved normal-seeded	Tiny-leaved tiny-seeded	Total
Observed No.	310	102	97	32	541.00
Expected on a 9:3:3:1 ratio	304.40	101.40	101.40	33.80	541.00
X ₂ —0.18; P—between 0.95-0.99. The fit is good.					

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ULTRASONIC WELDER

THE welding industry has a valuable new piece of equipment in a 2,000-watt welder, part of the *Sonoweld* line which utilizes ultrasonics to join similar and dissimilar metals without fusion, and with very little external deformation.

Ultrasonic welding is a solid state joining process in which the materials to be joined are subjected to high frequency alternating vibra-

tions, which are generated by the transducer in the welding head system and transmitted through the coupling members to the work being done. The resulting joints are accomplished without fusion, and, in many materials, exceed the strength of similar joints made by standard resistance welding methods.—J. Frank, *Inst.*, October 1958.

REVIEWS

The Evolution of Development. By J. T. Bonner. (Cambridge University Press, Bentley House, 200, Euston Road, London, N.W. 1), 1958. Pp. 102. Price 17s. 6d.

Dr. Bonner's controversial lectures given at University College, London, less than two years ago have now been printed. They were controversial because they demanded imagination and humility. His critics were whisked from subjects about which they had never heard, and therefore had no previous interest, to those about which they were so convinced that "they knew it all before" that they switched off mentally, and so did not recognise that it was at least being said "inside out", and often in consequence, it was not only surprising but constructive.

For example, Dr. Bonner's main attack is one of the most well-tryed in biology. He examines the efficient causes of an evolutionary advance by the method of comparing the many unsatisfactory attempts to solve it; as for example, an understanding of the function of the reptilian-avian egg may be sought in a comparison of the many kinds of terrestrial eggs of amphibia and fishes; and discussion of the "conquest of the land" requires an understanding of the stimuli that bring so many fish species up to gulp atmospheric air.

But Dr. Bonner applies this method to the very general problem of a repeated development of multicellularity from a unicellular zygote by each individual (*Sensu lato*) in every generation, and he can speak of the solutions not in this anthropomorphic, creationist, finalistic vocabulary which I have used, but as the result of past and continuing selection pressures. The nature of embryologist's material makes this especially difficult for them—witness their leanings towards Lysenkoism.

I think many young people may (perhaps) overestimate Dr. Bonner, because they will remember all their lives the excitement with which they read this book. It is especially recommended to Indian readers because it gives some glimpse of the *bhakti* which is inseparable from this sort of biological research in the West, and is so sadly rare in this country.

H. SPURWAY.

Biological Ultrastructure. By Arne Engstrom and J. B. Finean. (Academic Press, Inc., New York), 1958. Pp. ix + 326. Price \$8.00.

The field of biological ultrastructure and the molecular organisation in living systems has attracted a great many workers from diverse fields like histology, biochemistry and X-Ray crystallography. The results of their researches have contributed to the vast growth of the subject in recent times. The aim of the book according to the authors is to provide an introductory account of the subject to students and research workers in a variety of areas ranging from zoology and botany, medicine and pathology to biochemistry and biophysics. In this aim the authors have achieved good success.

Nearly a third of the book form the prologue to the main theme, developed in the rest of the pages, and deals with the methods in ultrastructural research and the principles of molecular structure. The latter topic is bound to be particularly useful to those who are not very familiar with the principles of stereochemistry and the reactives of the various simple molecular groupings. Though it is not possible to give, in a book of this size, anything but a short account of any of the topics chosen, one still wishes that the chapter on experimental procedures were treated in greater detail.

The subject-matter of this book—molecular organisation in living systems—is treated under five chapters, *viz.*, the role of proteins, lipids, nucleic acids, carbohydrates and minerals. These contain much of recent work on the structural models of many macromolecules, their aggregations and their mutual interactions. Wherever it is possible to speculate, ideas are given about the mechanism governing the synthesis of these macromolecules in the living systems and the subsequent formation of the morphologically distinguishable components. Perhaps some of the ideas presented in this volume are likely to be modified in the wake of further researches. But, as it is, the book gives an excellent account of the present state of knowledge and the trend of further research in this field.

The book is very well written: the presentation is remarkably original and the style generally very lucid. There are few misprints and the get-up is excellent. The most attractive

feature of this book is, however, the abundance of illustrations and diagrams—all beautifully reduced. The book will prove to be an important and a very useful aid to all those interested in biological research.

Y. T. THATHACHARI.

Bioenergetics. By Albert Szent-Gyorgyi. (The Academic Press, Inc., New York), 1957. Pp. x + 143. Price \$ 4.50.

This is a highly readable book written by one of world's greatest workers and thinkers in the field of biochemistry. It contains three almost equal parts: (1) General considerations, (2) Biological Structures and Functions, (3) On Drugs, Hormones and Diseases. The object of the book is stated as follows. One of the most characteristic features of present-day biochemistry is the co-existence of highlights with darkness, knowledge with ignorance. While we have an astounding knowledge about the processes in which our foods are used to build our body, we know nothing about how energy is driving life. The book represents an attempt to provide this knowledge.

In the beginning of the first part, the problem is stated clearly using the well-known subject of muscle contraction as example. The conclusion is reached that the energetics of the living world consist of only two processes: photosynthesis and its reversal. The energy stored up in the molecule by the former process is marked (E) and the excitational energy as E^* ; the transformation is then represented as $(E) \rightarrow E^* \rightarrow W$. The author then develops the idea of the transmission of energy from one part of a molecule to another by means of free electrons. The phenomenon of fluorescence is used to indicate that the molecule is capable of accepting and transmitting energy and does not dissipate it. In this process water plays an important part as a regulatory influence. Its capacity is attributed to its strong dipole nature and its tendency build structure-ordered layers around surfaces reaching deep into the fluid phase. The water structures built around dissolved molecules will vary with the atomic groupings involved. The dimensions and the nature of the 'ice bergs' will decide how far these molecules can approach one another and interact. A further conclusion is that within the water structure electronic excitations may assume an unusual long-lived form suited for biological energy transmissions. Water and the

electromagnetic field are thus considered to provide the matrix of life. In this line of thought the phenomenon of quenching and the part played by quenchers provide useful information regarding the mechanism of interference with excitation.

The ideas developed in Part I are applied in Part II to biological structures and functions. The explanation of molecular contraction is as follows: the myosin particle is kept stretched out by its water structures; contraction is induced by the collapse of these structures, the re-establishment of which is relaxation. The A.T.P. molecule is considered to be not only a storage battery, but also a transformer and it is able to perform its function because of the correct dispositions of the concerned oxygen and nitrogen atoms and for a similar reason riboflavin phosphate is efficient in oxidative phosphorylation. Then follows a discussion of the effect of ions, glutathione, sugars and alcohols, oxidative phosphorylation and uncoupling.

The final part dealing with Drugs, Hormones and Diseases starts with the declaration: "The author's research has always been dominated by the idea that there is but one living matter which has overgrown this globe's surface, taking on different shapes, sizes, colours and complexities, adapting itself to different conditions. In spite of the great variations in its appearance life is built on the same limited number of basic principles, wherever and in whatever form we meet it; there is no real difference between cabbages and kings. But if the foundations of normal life are simpler than its appearance, then the same may be true also for disease, and a great variety of symptoms can be caused by disturbance of single basic mechanisms, and the way in which disease declares itself may have no direct relation to the underlying cause". It is followed by an interesting discussion of a few typical drugs and of diseases, Myotonia, Myasthenia and Cancer.

The author concludes, "I have no doubts that the coming century will witness a profound revolution, extension of biology, the establishment of a quantum mechanical biochemistry, built on top of the Lucretian one. This book may be but one of the early swallows of this spring".

The book provides most fascinating reading and is fully thought-provoking. It is not a textbook for the uninitiated, but can provide the excitational energy for scientific adventure.

T. R. S.

The Spectroscopy of Flames. By A. G. Gaydon (Chapman & Hall), 1957. Pp. x + 279. Price 50 sh.

The great utility of the study of flame spectra lies in its ability to yield information about intermediate products in combustion processes. Since these intermediate products, called radicals, have a life-time of the order of 10^{-8} sec., their presence cannot be detected by any chemical means. Combustion plays a vital role in generation of energy in many important means of transport such as the internal combustion engines in motor cars, aeroplanes, etc. The advent of jet engines and rockets flying at speeds greater than that of sound (supersonic flow) give rise to phenomenon of shock waves, which are amenable to analysis by flame spectra. A book dealing with such wide applications of flame spectra is therefore greatly welcome.

In earlier years, the principal interest in the study of flame spectra lay in identifying the radicals giving rise to various spectra. Well-known among those were the water vapour bands (OH), hydrocarbon bands (CH) and carbon bands (C^2), which are also of great astrophysical importance. Now, however, successful efforts have been made to understand what part such radicals play in combustion processes. Since information about chemical reactions can be obtained by better control of the flame, or the nature of the reacting species, new experimental techniques have been developed, among which are flat flames, low pressure flames, low temperature flames, atomic flames, flash-photolysis, and shock tube excitations. These are described in Chapter III.

Three chapters cover discussions of the spectra of well-known flames, like hydrogen, carbon monoxide and hydrocarbon flames. The problems which arise in individual flames, such as the nature of the emitter of CO flame bands or the intensity distribution of OH bands are treated in detail. In a separate chapter (Chapter VIII) are described spectroscopic methods of measuring flame temperatures (vibrational, rotational and translational) which have yielded valuable data regarding the mechanism of production of different radicals.

Chapter X has been devoted to an interpretation of the spectroscopic data described in previous chapters. This deals with the nature of chemical reactions in cool flames, diffusion flames, premixed flames and the reactions forming excited radicals.

Flames produced in inaccessible regions such as the internal combustion engines and the jet

engines have been studied spectroscopically, which has thrown considerable light on the phenomenon of "knock" and the nature of exhaust flames in jet engines. These are discussed in Chapter XI.

Other flames, whose spectra are described in the book (Chapter XII), are various organic flames, like NH_3 , halogens, etc. Infra-red emission from flames is also included in a separate chapter (Chapter IX).

The book has several plates and an appendix giving data on the characteristics of band-spectra emitted by flames.

Spectroscopic studies of combustion is an important field of research, particularly with the advent of jet engines and rockets. A book devoted to such a subject is of considerable help to research workers in this field. The book will also be useful to those who wish to get acquainted with the contributions of spectroscopy to a better understanding of the phenomenon of combustion.

V. M. W.

Infra-red Absorption Spectra of Steroids—An Atlas, Vol. II. By G. Roberts, B. S. Gallather and R. N. Jones. (Interscience Publishers, New York), 1958. Pp. 95. Price \$ 20.

The highly characteristic infra-red absorption spectra exhibited by individual steroids have been often utilized for the identification of these compounds. As the amount of the compound involved is minute in quantity, this method of 'fingerprint' analysis is the simplest and at the same time most precise. The present volume contains, besides, an introductory chapter and table of characteristic group frequencies, 452 spectral charts of diverse compounds the region of absorption recorded ranging in general from 600 to $1,800\text{ cm}^{-1}$ and in some cases up to $4,000\text{ cm}^{-1}$. The present atlas will prove valuable to all laboratories engaged in the isolation, synthesis and identification of steroids and related natural products.

D. K.

Absorption Spectrophotometry. Second Edition. By G. F. Lothian. (Hilger & Watts, Ltd., London), 1958. Pp. viii + 246. Price 52 sh.

Most of the chapters of this second edition on absorption spectrophotometry have been rewritten to keep in step with the vast developments that have taken place in this subject since 1949, when the first edition was published. The book is divided into three parts dealing

with the principles, applications and techniques of spectrophotometry. In the first part are dealt, in detail, the effects of finite slit widths, measurements on diffusing specimens and the total intensity of a band. A few typical examples of the several growing applications of spectrophotometry are discussed in the second part. The third part is devoted to the modern instrumentation, which covers also the vacuum ultra-violet region. The design, operation and adjustment of the instruments and related topics like cells, solvents and standards also figure in this section. The book includes a list of publication on the subject for further reading and exhaustive references to recent original papers and commends itself as a valuable introductory text to students and workers in this field.

D. K.

Colorimetric Determination of Non-Metals.

Edited by David F. Boltz. *Chemical Analysis*, Vol. VIII. (Interscience Publishers, Inc., New York), 1958. Pp. xii + 372. Price \$8.50.

The literature covering the field of Colorimetry continues to grow. It is not always possible for any publication to keep pace with the published work on many divisions of Chemistry. In Colorimetry new methods, modified classical methods, improved techniques, and better instrumentation have resulted in many interesting developments.

This book is the eighth volume in the "Chemical Analysis" series of monographs published by the Interscience Publishers. This volume and the volume (Vol. 3) on "Colorimetric Determination of Traces of Metals" published by the same publishers together are intended to form a complete unit. The publication of a book of this type was overdue. Numerous methods have been perfected for the colorimetric determination of metals and a number of publications are available on this subject. However, reliable methods on the colorimetric determination of non-metals are meagre and they are mostly indirect.

The book is divided into eleven chapters and the first introductory chapter deals with the general principles and practices of colorimetric analysis under the heads of Visual and Photoelectric Colorimetry, Spectrophotometry, Turbidimetry and Nephelometry; specific methods to be adopted keeping in view the solution variables in the preparative procedures and the general procedures to be adopted for the separation and isolation of the desired constituents

from the interfering elements. The methods of separation and isolation of the concerned elements given in each chapter are clear and concise.

The second and subsequent chapters deal with the estimation of the various elements like phosphorus, silicon, nitrogen, chlorine, bromine, iodine, fluorine, sulphur, tellurium, selenium and boron. Each chapter is divided into three sections and the first deals with the separation and isolation of the particular element; the second deals with the methods adopted for the actual determination and the third with the specific applications of these methods.

The only leading method given for the determination of phosphorus (as orthophosphate) is as molybdenum blue (Heteropoly Blue) derived by the reduction of the phosphomolybdate or the phosphovanadomolybdate. The determination of silicon is also largely accomplished in a similar way by measuring the transmittance of the molybdenum blue or by measuring the transmittance and absorbance of the yellow molybdo-silicic acid complex. The determination of nitrogen is dealt with in great detail. The main principle is to convert the nitrogenous material into an ammonium salt, liberate ammonia and estimate it by the Nessler reaction. Nitrite is determined by diazotization and coupling reactions and nitrates by using either phenoldisulphonic acid or brucine as a reagent. Chlorine is determined using O-Tolidine while chloride is determined by using silver salts or mercuric nitrate. Chlorate and hypochlorite are determined by using benzidine and methylene blue for perchlorate. Bromine is determined either by König's reaction or by methyl orange, phenol red and rosaniline. Iodine is determined by its action as a catalyst and by the starch-iodine procedures. Fluorine is determined indirectly by displacement of a colour-forming ion from a complex like oxidised titanium solution, ferric thiocyanate, or a lake like that of alizarin and zirconium. Sulphur is converted into sulphates or sulphides and determined by turbidimetric methods or by reduction to hydrogen sulphide and determination by methylene blue. Selenium and tellurium are determined by reduction to the elemental form as coloured sols. Boron is estimated using quinalizarin or carminic acid or dianthramide in the presence of strong sulphuric acid or by curcumin in an alcoholic or aqueous medium.

At the end of every chapter a comprehensive and useful bibliography on the concerned subject is given and at the end of the book a

useful table of transmittance-absorbance conversion is given.

Considering the scope of the book it should be said that the chapter on phosphorus does not deal with the subject in full, particularly no procedure is given for the separation and estimation of phosphorus in soils and plants, in silicates, ores, etc. No reference is made about the determination of oxygen, ozone, carbon and its oxides and major organic compounds. The authors have no doubt taken great pains in selecting their material and making each article as concise as possible. But it would have been more helpful if sufficient data had been given on the subject of the actual preparation of the solution from the various materials that are to be tested.

The book is well written and presented and would be extremely useful to all students of analytical chemistry.

N. JAYARAMAN.

Surface Active Agents and Detergents. Vol. II.

By Anthony M. Schwartz, James W. Perry and Julian Berch. (Interscience Publishers, Inc., New York), 1958. Pp. xv + 839. Price \$ 17.50.

Literature on the chemistry and applications of surface-active substances is growing at such an enormous rate that great effort is needed to keep abreast with the up-to-date advances in any particular branch of this subject. The immensity of the task can be gauged by the fact that between 1948-56 there are nearly seven hundred publications dealing with the processes for synthesising and manufacturing surfactants. When authors undertake such a stupendous task, it is only natural that they cannot give a critical account of every aspect of the subject-matter dealt with. But this is more than compensated by the extensive and exhaustive survey of the literature.

The volume is divided into four parts: Part I dealing with the processes for synthesising and manufacturing surfactants and Part II with special function surfactants and compositions, in which the surfactants are functionally classified into ten sections like surfactants for non-aqueous systems, for germicidal and fungicidal applications, anticorrosive compositions, textile processing applications, etc. Grouping of this type will be of great advantage to industrial chemists who can have an outline of the applications of surfactants in their specialised branch of study. But the sections on analysis and analytical behaviours of surfactants, in-

organic and organic builders and additives used with surfactants are out of place in this part. Part III is devoted to the Physical and Colloidal Chemistry of surfactants in theory and practice. In this part the Physical Chemistry principles of surface processes like adsorption and surface layer formation, bulk properties of surfactant solutions, foaming, wetting, emulsification and detergency are outlined. This part, although quite informative for a beginner, is a bit disappointing to a specialist in theory; perhaps the space allotted was inadequate for a detailed discussion of the theory. Part IV gives a fund of information regarding the practical applications of surfactants to a variety of industrial and miscellaneous purposes. The book is very well got up and the printing is excellent. Typographical errors are very few indeed and the authors are to be congratulated for bringing out this valuable book which is indispensable to any chemist interested in the theory and practice of the surfactants.

M. R. A.

Enzymes. By Malcon Dixon, F.R.S. and Edwin C. Webb, M.A., Ph.D. (Published by Longmans Green & Co.), 1958. Pp. xxxiii + 782. Price 90 sh. net.

The ever-increasing tempo in enzyme research certainly needs a standard text-book on the subject for purposes of ready and facile reference. Such a need is admirably filled by the book under review. It is an authoritative treatise on the general principles of enzymology rather than its methodology. It imparts rather than informs and is, therefore, thought-provoking. It is excellent for its matter, for its presentation and for its get-up. It is written in an expert way in classroom lecture style, masterly in arrangement and clarity. Many tables are presented, docketing useful information in a condensed form. This is a novel and welcome feature of purveying information and is worth emulating in general, in text-books. The title of the book is not sufficiently indicative of the depth, range and richness of information provided, nor of the method of treatment. No review can do adequate justice to its value. One may get perhaps some measure of it if it is pointed out that the authorship is steeped in the best traditions set by that great master, Hopkins, with whose many sage words, the book begins, resounds and ends, and, therefore, glows.

Basic knowledge about enzymes more than that contained in the introduction would be

necessary to follow the rest of the 12 chapters written in the esoteric language of enzymology under the captions, "Techniques", "Isolation", "Kinetics", "Reaction", "Specificity", "Mechanisms", "Inhibitors", "Cofactors", "Structure", "Formation", "Systems" and "Biology". This arrangement follows in a sense the stages in the development of our knowledge on this dynamic subject.

As occasionally happens even in the best prepared lecture, there are minor defects of omission and commission. For example, every one will not agree with the authors that the device sometimes adopted by them of referring to the enzymes by their numbers (given to them in Table V, 1) is the most convenient. Some of the foot-notes (cf. pp. 395, 568) are unduly long and act as a lump in reading the text. Though a bibliography arranged in alphabetical order according to the first author is provided, still an author index was necessary in fairness to all the collaborating authors in a conjoint effort. The rare collection of microphotographs of crystalline enzymes given in the opening pages could have been presented in an alphabetical order. In the chapter on "Enzyme Techniques", a sub-title "Classes of Methods" does not appear to be quite exact. Dilatometric methods once used in kinetic studies do not find a mention. In describing tests for dehydrogenase activity (pp. 30-31) omission to refer to methods based on the use of the tetrazolium salt as an electron acceptor is a little puzzling. "Enzyme Kinetics" has deservedly met with the most detailed treatment. Chapter V is unique because of the novelty in presentation. It contains an exhaustive table listing 659 enzymes, grouped functionwise, giving against each enzyme information concerning active groups and cofactors, source, substrate or reaction with references. Preceding text is a description of the table, while the succeeding one is devoted to a more detailed discussion. Available information on the specificity of enzymes has been marshalled in Table VI, 1. As against this, Table VI, 5 relating to the specificity of glucose oxidase is an offender and looks odd, containing, as it does, almost a whole column of zeros (because with each of the 39 substrates cited, the rate of oxidation is zero). Co-enzyme I and Co-enzyme II get special treatment and steps involved in arriving at their configuration are described in detail. It is difficult to justify the major treatment given in insulin in several contexts in the book. In dealing with the reducing properties of ascorbate (p. 409), it would have been more

realistic to have referred to reducing capacity of ascorbic acid towards acid silver nitrate. In showing the difference in the configuration of folic acid and its anti-vitamin aminopterin (p. 446), the differing groups could have been distinguished in bold print. As regards the influence of metal ions, the following statement (p. 448) "Some ions are poisons for some enzyme and activators for others: some may even inhibit an enzyme at one concentration and be an activator of the same enzyme at another" needs support from examples and literature references. The chapter on "Enzyme Structure" is incommensurate with the promised fare. Real knowledge giving some insight into enzyme formation is comparatively a recent acquisition, having had to depend on the development of tracer technique for providing evidence. These results only bear out, as the authors point out, the obvious conclusion that the biosynthesis of an enzyme is ultimately the biosynthesis of a protein, the explanation for modification into an active species being sought in genic control. In the last chapter under the heading "Enzyme Biology", such speculative subjects as enzymes in relation to life and their origin are discussed freely. Perhaps the authors could have risked a little more and taken a peep into less chartered areas and given us a travelogue of the looming pastures like aromatisation and unfathomed seas like the phenomenon of optical activity.

This authoritative and comprehensive book will be widely welcomed by students and research workers in the field and is sure to remain a standard reference on enzymes till it is replaced by the next edition by the authors themselves.

M. SRINIVASAN.

Methyl Glucoside. By C. N. Bollenback. (Academic Press, Inc., Publishers, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. 189. Price \$ 5.50.

The book under review deals with the occurrence, preparation, physical constants and derivatives of methyl-D-glucopyranosides and methyl-D-glucofuranosides. It contains well over 500 references collected up to 1956, as well as unpublished information from the records of Corn Products Refining Company with which firm the author is connected. The section on the derivatives is the largest and is valuable to those interested in the various uses of these substances. Certain derivatives such as the anhydro and deoxy compounds have not been

included in this book, as useful reference library on these is available.

The general arrangement and get-up of the book are indeed excellent. The book is, however, of interest only to the specialist working in the field and will be a useful addition to any reference library.

N. V. SUBBA RAO.

New Frontiers of Knowledge. (Public Affairs Press, Washington, D.C.). Pp. x + 125. Price \$ 2.75.

This book is based upon the series of talks broadcast by the U.S. Information Agency during the year 1957. Although known in parts to many through the press and the radio, this publication in a collected form will be welcomed by the general reading and thinking public.

"The frontiers of knowledge and humanity's hopes for the future" was, in essence, the main theme on which distinguished men of the world were invited to participate. Here we have 36 men belonging to 14 different countries drawn from such varied fields as philosophy, mathematics, religion, law, government, history, economics, education, literature, anthropology, biology, psychiatry, medicine, physics, technology, planning and co-operation, giving their considered opinions, based on experience and deep thought, on the new problems facing mankind in this nuclear era.

Evidently the staggering advances in science and technology and the growing expansion in the frontiers of knowledge are creating new problems. From one point of view the effect of the increased speed of scientific and technological processes is, as John Von Neumann says, "that it has not only enlarged the size of political, economic and cultural units, but it has also at the same time increased the danger of collision among nations, among economies, among cultures."

From another point of view, these rapid advances in science have created an awareness in the minds of men and the achievements of science are looked upon not with admiration but with philosophical thinking on the Universe, the creation and the purpose of living. As Bridgmann says "the most important impact of science is not in its transformation of the external conditions of our daily living, but in something deeper, namely, in our complete world outlook". According to Arnold Toynbee "the rise of modern science has created a spiritual vacuum in man", and as science has expelled religion, he pleads for the "recovery of religion",

The ordinary man, standing in the mid-20th century on the threshold of a new age looking around to the rapidly expanding tiers of knowledge, can only watch, perhaps think, but he cannot come to any conclusion. It is here that this little volume containing the thoughtful convictions of learned men of the world from different spheres of activity comes to his aid and gives him hope to face the future with confidence that the tremendous force that has been discovered will be directed not toward death but toward life.

A. S.

Organic Syntheses with Isotopes—Part I. Compounds of Isotopic Carbon. By Arthur H. E. Ray and D. Lloyd Williams. (Interscience Publishers, New York, London), 1958. 1146. Price \$ 25.00.

The need for a compilation such as the volume under review has been increasingly felt because of the growing popularity of tracer methods. Details of synthetic procedure with isotopes are scattered throughout the scientific literature tending from Agriculture to Zoology and embracing many different languages. It is not easy for a prospective user of an isotopically labelled compound to find out whether the compound under question has already been synthesized or not, unless he has ready access to a vast reference library. Moreover, in the current scientific literature the practice of giving experimental details of new isotopic syntheses does not seem to be popular. In most cases a new synthetic procedure is presented in the barest outline.

Syntheses of labelled compounds involve the best techniques and skill the organic chemist can put forward and something more. The high price of isotopes and very often the difficulties associated with the use of them require that the synthetic procedure be carried out with a high degree of precision which is not necessary in non-isotopic organic synthesis. Usually the synthesis of a labelled compound which is described as a condensed short paragraph in scientific literature represents months and sometimes years of hard work comprising of standardizing the best conditions for the synthesis in isotopic pilot runs, the reproduction of the best yields with trace amounts of isotopes, proof by unambiguous methods of the identity of the desired product and of the distribution of the isotope in the molecule and the full-scale isotopic synthesis. Furthermore, the ingenuity of the investigator is very

put to the test to obtain the maximum isotopic recovery in the desired product.

The authors, therefore, are fully justified in suggesting in the preface that the book should not be confined in its uses to the labelled compounds alone but it should be of considerable interest to the organic chemist, as the procedures were chosen for or developed to give high yields. Among many interesting examples, the dihydrosorcinol procedure for synthesis of long chain fatty acids and the elegant syntheses of many aminoacids involving the substituted hydantoins may be of interest to the organic chemist.

It is noteworthy that already some confusion has developed in literature regarding the nomenclature of isotopically labelled compounds and the precise formulation of six basic rules of nomenclature in the introductory chapter is timely and useful. The introduction also deals with some essential information about the properties and procurement of isotopes and a brief outline of tracer methodology. Cross-references are given to the standard literature on these subjects to assist the new-comers in this field.

The different classes of labelled compounds have been arranged alphabetically beginning with the acids and concluding with the vitamins. The syntheses of a few key intermediates, such as acetate, formate, cyanide, etc., are dealt with in exhaustive detail including alternative methods. New equipments used have been described and illustrated in many cases. Dr. Murray has the distinction of being one of the pioneers in radiocarbon syntheses and the subtle tips regarding the procedure from the accumulated experience of the authors and other workers in this field described in the notes following the experimental procedure would be of great assistance to the users of this book. The description of each synthesis follows closely the standard sequence adopted in Organic Synthesis—the experimental procedure, notes and suggestions, alternative methods and a wealth of references.

It would have been better to include an index at the end of each volume instead of a cumulative index with Part II which deals with the synthesis of organic compounds labelled with isotopes other than carbon. Such a procedure would have saved the user the inconvenience of handling two bulky volumes instead of one. The reviewer hopes that this small oversight will be rectified in the subsequent editions.

The book should be unreservedly recommended for every organic chemistry library.

P. K. B.

The Nucleus. (*An International Journal of Cytology and Allied Topics.*) Published in two issues a year. [Editorial Office, Kalputuru Palace, 223, Chittaranjan Avenue (North), Calcutta-6.] Price Rs. 13-00 per issue.

It is a pleasure to welcome the first issue of *The Nucleus* edited by Dr. A. K. Sharma with the aid of Advisory Board composed of leading cytologists like Prof. Kihara of Japan, Prof. Riley, Prof. Taylor and Dr. Kaufmann of U.S.A., Prof. Oehlkers of Germany, Prof. Love of Canada and Prof. Sirks of Netherlands.

The get-up is attractive and the reproduction of photographs good. If the standard of contributions in this issue is any indication the journal has a promising future.

M. K. SUBRAMANIAM.

Books Received

Potato in West Bengal. By H. C. Choudhuri. (Department of Agriculture, Govt. of West Bengal, Writers' Buildings, Calcutta), 1958. Pp. 125. Price Rs. 6.

Industrial Hygiene and Toxicology—General Principles, Vol. 1. Second Revised Edition. Edited by F. A. Patty. (Interscience Publishers, New York), 1958. Pp. xxviii + 830. Price \$ 17.50.

Mycology and Plant Pathology. By S. N. Das Gupta. (Indian Botanical Society, University Botany Laboratory, Madras-5), 1958. Pp. iv + 118. Price Rs. 5.

Animal Disease and Human Health. By J. Lieberman. (*Annals of the New York Academy of Sciences*, New York), 1958. Vol. 70, Art 3. Pp. 277-762.

Nuclear Scattering. By K. B. Mather and P. Swan. (Cambridge University Press, London N.W. 1), 1958. Pp. viii + 469. Price 80 sh.

Grundriss Der Photographie Und Ihrer Anwendungen Besonders in Der Atomphysik. By G. Joos and E. Schopper. (Akademische, Verlagsgesellschaft, m.b.h. Frankfurt am Main), 1958. Pp. xii + 408. Price not given.

Palæmon. By S. S. Patwardhan. (The Zoological Society, Calcutta-12), 1958. Pp. xiv + 102. Price Rs. 5.

Solid State Physics—Nuclear Quadruple Resonance Spectroscopy. By T. P. Das, E. L. Hahn. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. ix + 223. Price \$ 7.00.

SCIENCE NOTES AND NEWS

Veb Carl Zeiss Jena at the Indian Science Congress Exhibition, New Delhi, Jan. 1959

Messrs. Gordhandas Desai (Private) Ltd., Bombay-1, write that their Principals *Veb Carl Zeiss Jena* will be participating in the above Exhibition with a very representative display of their production programme. Their latest instruments will be exhibited at Stall No. 11.

Of special significance on this occasion will be the presence of six experts from the Zeiss Works who will personally attend the Exhibition. After the Exhibition these experts will undertake a tour for a duration of one month of the country to personally attend to matters such as the choice of equipment for special work and intended projects in research.

Lady Tata Scientific Research Scholarships, 1959-60

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1959-60 commencing from 1st July 1959. Applicants must be of Indian nationality and *Graduates in Medicine or Science* of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1959. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, "Bombay House", Bruce Street, Fort, Bombay-1.

Racine Prize for Mathematics

A cash prize of the value of rupees one thousand, will be awarded to the best research paper in mathematics published before 31st December 1961 by an Indian Mathematician who is under 30 years on that date. Unpublished manuscripts or papers in the course of publication on that date will also be accepted for consideration for the award, if four typewritten

copies of the same are sent, before the said date, to the address given below. An international panel of judges will be constituted to adjudicate on the award.

All communications should be addressed to Dr. K. G. Ramanathan (Convener, Racine Prize Committee), Tata Institute of Fundamental Research, Apollo Pier Road, Bombay 1.

Award of Research Degree

The University of Poona has awarded a Ph.D. Degree in Chemistry to Shri Shashikar Avantilal Vasavada for his thesis "Studies in the Autoxidation of Fats".

2nd International Congress of Polarography

The above Congress organised by the Polarographic Society will be held in Cambridge from 24th to 29th August 1959. Prof. Heyrovsky, Head of the Polarographic Research Institute of the Czechoslovakian Academy of Sciences, has agreed to give the opening address. The proceedings will be published in book form and will be dedicated to Prof. Heyrovsky's 70th birthday.

The scientific programme will be divided into the following Sections: 1. Instrumentation 2. Theory and Kinetics, 3. Analytical and Industrial Applications, 4. Fundamental Studies 5. Biological and Medical Applications, and 6. Miscellaneous.

Contributions will be welcome and should be submitted to: G. F. Reynolds, M.Sc., F.R.I.C. C 36 Royal Arsenal, Woolwich, London S.E. 18. Abstracts not exceeding 200 words should be received by 31st March 1959, and final manuscripts by 31st May 1959.

For further details write to: Mrs. B. Lamb, B.Sc., F.R.I.C., Chemistry Laboratory, Evershed and Vignoles, Corner of Eveagh Avenue, North Circular Road, London N.W. 10, England.

The Institute of Physics

A one-day symposium entitled "Current developments in the production of high vacuum" will be arranged in London on 17th April 1959.

There will be three sessions: (a) Chemical and ionic pumping in kinetic vacuum systems (b) Problems in the production of high vacuum in large equipment; (c) Analysis of residual gases in kinetic vacuum systems.

A Conference on "Some aspects of magnetism" will be arranged in Sheffield from 22-24 September 1959.

The subjects to be covered by the conference are: (a) Fundamental theories of ferro-, ferri- and antiferromagnetism, including magnetic structure, (b) Theories of technical magnetization processes, including hysteresis, coercivity, anisotropy and directional effects, (c) Theoretical and experimental studies of domain phenomena in bulk materials and thin films, (d) Experimental and theoretical studies of antiferromagnetism in metals and non-metals.

These are intended mainly for persons working in the field. All communications regarding the symposium should be sent to the Secretary, The Institute of Physics, 47 Belgrave Square, London S.W. 1.

Industrie Chimique Belge—Special Issue

The XXXI International Congress of Industrial Chemistry organized in Liege by the Federation of Chemical Industries of Belgium, was held during the Brussels World Exhibition. About 350 lectures and papers of a high scientific value have been presented on this occasion, on subjects covering almost the entire field of the chemical and para-chemical industries. The periodical "Industrie Chimique Belge—Belgische Chemische Industrie" will bring out before long a special issue, in which the full texts of all lectures and papers together with the interventions and discussions will be published.

This special issue will undoubtedly be of considerable interest for all those concerned with the development of the applied chemistry. Subscriptions to this Congress Report, the price of which has been fixed at 1800 B.F. should be sent to the General Secretariat, 32, rue Joseph II, Brussels, Belgium.

Magnetic Recording by Electrons

A way of using a magnetic film and an electron beam to produce stable but erasable records of information is being developed by Ludwig Mayer of Minneapolis. He calls his technique "Curie-point writing". The Curie point of a magnetic material is the temperature at which its magnetism is destroyed. The manganese-bismuth discs which Mayer is using have a Curie point of 350° C.

He preheats the discs to 300 degrees, fully magnetised in one direction. He then writes on them with an electron beam, which is made to move by ordinary TV methods. The effect of the beam is to heat the film where it strikes

above the Curie point. Thus, the magnetism along the trace of the beam is destroyed, and when these regions cool down again below the Curie point they become remagnetised under the influence of the rest of the film; consequently they are magnetised in the opposite direction to the rest of the film.

The writing can be read using light or electrons. It can be made to appear black on a light background if the film is observed under polarised light. Alternatively (by the technique of the electron mirror microscope) electrons reflected from the film are so affected by the magnetic field at the boundary between the writing and the rest of the film that, in the micrographs, the writing appears like raised humps on the film.

The first experiments established that 100,000 bits of information could be stored on one square centimetre of film, and written on in about 3 seconds. Mayer is confident that the writing speed can easily be increased tenfold, and that half-tone magnetic images could be produced by varying the sizes of the "black" dots. Any impression can be instantly erased by a magnet, provided the heating used in the writing is not excessive.—*Journal of Applied Physics*, Vol. 29, p. 1454.

Ceramic Electret Microphone

Organic electrets of resins, wax and rubber have been known for many years. Ceramic electrets belong to a new class of dielectrics which have been developed at the Physics Institute of the USSR Academy of Sciences. A plate of this substance when heated to 200° C., and gradually cooled in a strong electric field acquires the property of storing up opposite charges of electricity on its two sides and retaining them for many years. Electric energy is frozen at it were in the processed plate and can later be utilized in various instruments.

A ceramic electret microphone consists of a disc of this processed plate with the vibrating membrane superimposed on it. Telephones with these microphones, it is reported, have been working in the Institute for over a year without any outside source of power. Only the ceramic plates need be changed to ensure continued functioning. A ceramic electret microphone is superior to other types in clearness of sound and effective range. It is not affected by outside mechanical or temperature influences.

Ceramic microphone is only one of the ways of using this new class of dielectrics. Inorganic electrets are opening up broad prospects for the

development of new radio equipment and high precision measuring instruments. They have been used in radioactivity dosimeters of great precision. An electret voltmeter is found to be ten times more sensitive than a conventional one.—*USSR News Bulletin*.

Superfluid State of Nuclear Matter

The hypothesis of the superfluid state of nuclear matter was first advanced by Nikolai Bogoliubov of the USSR Academy of Sciences in his report to the Second Atoms for Peace Conference in Geneva. According to this hypothesis elementary particles in an atomic nucleus are paired as are electrons in a superconducting metal and atoms in liquid helium. This hypothesis was confirmed by Prof. Migdal's experiments. Speaking before Moscow scientists at the Physical Problems Institute headed by Academician Pyotr Kapitza, Prof. Migdal stated that by means of Bogoliubov's theory and mathematical method he was able to carry out one of the most precise experiments in the sphere of the structure of nuclear matter. His measurements of the torque of atomic nuclei revealed that it was not the entire mass of the nucleus that was rotating but only a small part of it—its envelope. This phenomenon, in his opinion, constitutes direct proof of the superfluidity of atomic nuclei.

Prof. Migdal considers that the discovery of the new phenomenon will not only make it possible to study transformations occurring in the atomic nucleus but also shed light on the nature of certain stars. He replied in the affirmative to the question about the possible existence of superfluid stars the bulk of which is composed of nuclei of neutrons alone.

He stated that the pair bonds formed in a nucleus by protons and neutrons are evidently not the only force operating in the atomic nucleus. Academician Pyotr Kapitza pointed out that the pair bond between nuclear particles removed from each other was a new fundamental phenomenon which until now escaped physicists' attention.—*Soviet News*.

Tracer Technique to Study Gibberellic Acid Mechanism

Gibberellic acid is one of the few natural growth regulators that has been discovered in plants. Gibberellin compounds were first discovered in a species of fungus in Japan. Gibberellic acid, which is now commercially available, is in the form of a fine white powder which is usually dissolved in solution and applied to plants in spray or droplets. It can make the stems grow

longer, increase the length of the leaves, improve the fruit yield, and act as a substitute for light or temperature in some germination and flowering processes. Because it can produce such a variety of responses, scientists think it will help them to obtain a better understanding of the hormonal mechanisms that control growth patterns in higher plants.

Plant Physiologists at Argonne are using the radioactive tracer technique to find out how plants utilise the acid. In this method "tagged" atoms of gibberellic acid which emit flashes of radioactivity detectable by monitoring instruments are traced wherever they go in the plant system. To make a radioactive form of the acid, Argonne scientists introduced sucrose labelled with carbon-14 into the fungus in which it is found. The hormone was then isolated by chemical means. Work at Argonne has already demonstrated that hemp, tobacco, lupine, sunflowers and bean plants are responsive to acid. In west coast areas of the U.S.A., grapevines treated with gibberellic acid have produced a greater yield of fruit per cluster.

Using hemp plants, Argonne scientists noted a new growth-regulating effect of gibberellic acid. In hemp, female and male flowers are developed on separate plants. But female plants treated with hormone also formed functional male flowers, thus altering the normal pattern of flower expression. The quantity of acid needed to induce changes in plants may be as little as a thousand-millionth of a gram. In the Argonne experiments, the acid is applied to plant in drops, with device that resembles a minute eyedropper. The researchers have already found that plants tested by the laboratory distribute the acid most uniformly if it is applied to the stem.

The work is still in its early stages, and much remains to be known about what plants do with the substance. However, in addition to furthering basic knowledge of plant mechanisms, research with the hormone will open the door to a number of future applications involving chemical control of plant growth and behaviour.—*Atoms for Peace Digest*, November 1958.

How Life Began

Hydrocarbons and their simple derivatives began to appear in the earliest period of the Earth's history, but they were merely initial compounds, the first link in a long chain of transformations on the surface of a still lifeless Earth. In his report, Academician Oparin, who is regarded as the World's leading authority

on the origin of life, stressed that mechanical materialism had proved incapable of giving a well-founded answer to the question of how life began. He said that only dialectical materialism, which considered matter in constant motion and development from the simplest forms to more complex ones, had opened up the way to a solution of the problem.

Oparin believes that the entire history of the development of matter towards the appearance of life can be divided into three stages: the primary appearance of hydrocarbons and their derivatives, the appearance of numerous high molecular organic compounds and, finally, the appearance of albumen systems capable of metabolism. He told the conference that the possibility in principle of the second stage in the development of matter—from the simplest hydrocarbons to extremely complex organic substances—resided in the primary hydrocarbons themselves.

Under the action of radiant energy, and in particular ultra-violet light, electrical discharges and ionising radiation, hydrocarbons turned into complex organic systems. However, organic systems did not possess the specific properties of life when they first appeared. It was only later that they developed into primary living organisms. The data available, Alexander Oparin continued, "indicate that primary organic polymers were educed from a homogenous solution at a certain time in the form of multi-molecular drops similar to the coacervate drops we have obtained in laboratory conditions. Each of them had its own particular structure.

Oparin pointed to three stages in the evolution of coacervate systems into living organisms; the development of an ability of self-preservation in conditions of constant interaction with the environment; the emergence of systems capable not only of self-preservation but also of growth, and the emergence of systems reproducing themselves in recurring reactions of the same type. "From that moment on," Oparin said, "life can be said to have appeared."—*Soviet News*, 11th November 1958.

Microhydropower Station

Semyonov, engineer of the Tyup Repair and Service Station (RSS), has invented an easily transportable small hydropower station which can be installed in streams running down mountain slopes for the production of electric power.

The microhydropower station consists of a 4.5 kw. generator and a turbine. In order that the microhydropower station could operate, a stream of 100 litres of water per second falling

from a height of three metres is necessary. The generator and turbine are mounted on a special iron frame. It can be disassembled and transported on animals to the remotest parts of mountain pastures. In order that the station could operate smoothly the only thing required is the regular lubrication of the turbine's shaft bearings and the countershaft after which no further servicing is needed for a long time.

In the 10 kw. microhydropower stations which are being manufactured in the RSS workshop, there is a closed type jet turbine, the water will first come into the vortex chamber and will then press on the blades of the turbine shaft.

These are being largely used in collective farms situated far out in the mountains.—*Soviet Science Bulletin*.

Electric Station without Generators

An unusual boiler is on view in the Inventors and Rationalizers of Agriculture Pavilion of the USSR Agricultural Exhibition in Moscow. It produces steam, hot air and even electric current without a generator.

The sources of electricity are semiconductor thermoelectric batteries built into the boiler. They resemble matchboxes in form and are made of a special alloy which is capable of transforming heat directly into electricity. The batteries are heated in an unusual way—one side of them is constantly in contact with the boiling water at 100° C. and the other with the gases from the burning fuel at 700° C. This difference in temperature is sufficient for the batteries to produce enough electricity to use for lighting homes, for motors, a radio station, the work of a forage-preparing shop and other purposes.

The installation will be in wide use in farms located at great distances from big communities and sources of power.—*Soviet Science Bulletin*.

Russian Cosmic Rocket

What was indeed a spectacular step forward in space research and an outstanding achievement in accuracy was accomplished when Russia launched a cosmic rocket on January 2, 1959. The rocket had exceeded the second cosmic speed necessary for interplanetary flights. On January 4, the rocket reached its nearest point of approach to the moon, 3500 miles, passed by it and set out on its onward journey to its planetary path around the sun. On January 7, the rocket started on its orbit round the sun as the first man-made planet. It is expected that the artificial planet will pass within observable distance of the earth once in five years.

The last stage of the rocket weighing 1472 kg. without fuel, was equipped with a special container inside which were placed the measuring instruments for carrying out the following scientific observations: Magnetic field and radio-activity of the moon; Intensities and intensity variations of cosmic rays outside the earth's magnetic field; photons and heavy nuclei in cosmic radiation; gas components in interplanetary matter; corpuscular solar radiation; study of meteoric particles. Data about Moon's magnetic field, if it has one, will throw light on the current hypothesis that the magnetic fields of celestial bodies depend on their rotation.

For observation of the flight of the last stage of the rocket there have been installed in it a radiotransmitter operating on two frequencies—19.997 Mc and 19.995 Mc-emitting beats lasting 0.8 and 1.6 seconds; a radio transmitter on 19.993 Mc, emitting beats of variable duration of .5 to .9 seconds used to transmit scientific observations data.

The total weight of scientific and measuring instruments together with sources of current supply and container is 361.3 kg. Data sent back to earth had all been received and are now being deciphered. When completed, which will take some time, the results would be made available to the whole world.

The rocket carried a special device to create a sodium cloud of an artificial comet. "The sodium cloud" the original announcement said, "will be formed on January 3, at about 0357 (Moscow time) and it will be visible for about two to five minutes in constellation of Virgo, approximately in the centre of a triangle formed by the stars Alpha Bootes, Alpha Virgo, and Alpha Libra". The cloud has been observed and photographed.

When on October 4, 1957, the world's first artificial earth satellite was successfully launched the *first cosmic speed* of 8 kilometres (about 5 miles) per second was obtained for the first time.

The present cosmic rocket had exceeded the *second cosmic speed* of 11.2 kilometres (about 7 miles) a second to become an artificial planet of the sun, having completely escaped the earth's attraction.

According to Professor Boris Kukarkin, Vice-Chairman of the Astronomical Council of the

Soviet Academy of Sciences, it does not now appear to be a difficult task to send a rocket outside the solar system. If advantage were taken of the earth's "fling"—its own velocity—and if a rocket were launched in a certain direction the *third cosmic speed* would be attained.

Does the Sun's Atmosphere Extend out to the Earth?

In a discussion on Space Research held by the Royal Society, Prof. D. R. Bates pointed out the remarkable implications which new data on air density, obtained from satellite observations, have concerning the heat flow conditions in the outer atmosphere. It appears that a source of heat from outside the Earth, considerably stronger than supposed hitherto, must exist. There is a possibility that this is connected in some way with Prof. Sydney Chapman's suggestion that the Earth must be regarded as a cold spot within the hot outer extension of the Sun's atmosphere. It has been known for some time that the bright disc of the Sun which we normally see is surrounded by a tenuous atmosphere, known as the solar corona, which extends out to distances several times the diameter of the visible disc. This corona is visible at eclipses and can be photographed by special techniques at other times. It is known also that the temperature of the corona is as high as 1,000,000° C. For certain theoretical reasons Chapman believes that it extends out much further than previously thought, cooling gradually as it recedes from the Sun so that near the Earth its temperature has fallen to 200,000° C. Even though the coronal density near the Earth would be quite small, amounting to only a few thousand particles per cubic centimetre, it might because of its high temperature, provide sufficient heat to resolve the difficulties pointed out by Bates.

An important task for interplanetary probes will clearly be to determine whether the Sun's atmosphere does extend out to the Earth. This involves measurement of the concentration of particles in space and of their nature. Almost all of these particles will be charged, consisting of protons and electrons. In addition the temperature, or what is equivalent, the average energy of these particles would need to be determined.—*The New Scientist*, November 20 1958.

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CHRISTIAAN HUYGHENS AND THE WAVE THEORY OF LIGHT: Part I

SIR C. V. RAMAN

1. INTRODUCTION

THE world, as we perceive it, is pictured for us by the rays of light which proceed from each point of the objects around us and form images of these objects on the retinae of our eyes—a statement which needs no amendment even when the aid of optical instruments such as the telescope or the microscope is invoked to enlarge our powers of vision. To put it a little differently, the principles of geometrical optics suffice to describe the behaviour of light as commonly experienced—*viz.*, that the rays of light are propagated in straight lines; that the angles of incidence and of reflection are equal; and that in refraction the rays of light are bent according to the law of sines. In his celebrated *Traite de la Lumiere* published in the year 1690, Christiaan Huyghens showed that these facts of experience are consistent with the hypothesis that light is in the nature of wave-motion propagated through space and can indeed be satisfactorily explained on the basis of that hypothesis. The treatise of Huyghens contains much other material of importance; a perusal of it leaves on the mind of the reader the impression that it is a masterpiece of scientific thought and exposition which possesses an enduring value and interest.

In connection with some experimental studies on the diffraction of light undertaken by the present author—the results of which will be published in the *Proceedings of the Indian Academy of Sciences*—the need was felt for a careful study of the original ideas of Huyghens. The task was made much easier by using the literal translation of his treatise from the original French into English by Sylvanus P. Thompson published by the Chicago University Press in the year 1912. The results of the study were surprising; it emerged that the ideas put forward by Huyghens in the first three chapters of his book are far from being what they have been represented to be by later writers. It also became clear that this misunderstanding of Huyghens' ideas invalidates a great deal of what has been written about the so-called "Principle of Huyghens" and especially the use made of it for the explanation of the phenomena of diffraction of light. It is the object of the present communication to give a *precis* of the contents of the first three chapters of

Huyghens' treatise. In the second part of this communication, some comments on the writings of later authors relating thereto will be presented.

2. THE NATURE OF LIGHT

In the first few pages of his book Huyghens set out the considerations which led him to infer that light is in the nature of a movement which spreads into space in all directions from a luminous source. He remarks that the terrestrial sources which are observed to emit light such as fire or flame evidently contain bodies in rapid motion. Then again, when sunlight is collected by a concave mirror and concentrated on material objects, it has the same effects as fire, *viz.*, it disunites the particles of those objects. It is therefore natural to suppose that light is itself some kind of motion and that the sensation of light is excited when such movement is communicated to the nerves at the back of the human eye. Huyghens also remarks on the extreme speed with which light spreads on every side and on the circumstance that when light comes from different regions, even from those directly opposite each other, the rays traverse one another without hindrance. The facts indicate that light is a movement transmitted through space and not a transport of matter which reaches the eye from the source of light.

To account for the very high velocity of propagation of light—known from the observations of Römer on the eclipses of Jupiter's satellites—and the fact that light can pass through empty space, Huyghens proposed a physical picture of the ætherial medium which could explain its power to transmit waves with such high velocity. He suggested that the æther of space consists of an immense number of extremely small and extremely hard spherical particles in close contact with each other. Experiments on the percussion of elastic solid spheres on each other show that a medium of the nature postulated could propagate waves simultaneously in all directions with high velocity and in such manner that waves travelling in different directions at one and the same time would not hinder each other's progress. Huyghens further recognized that every luminous object would necessarily contain an immense number of centres emitting

light and that from each of such centres thousands of waves might emerge in the smallest imaginable time ; he pointed out that these considerations would make it easier to understand, why in spite of the enfeeblement of the individual waves by their spread through immense distances, the light of the distant stars continues to be perceptible to human eyes.

3. THE RECTILINEAR PROPAGATION OF LIGHT

The mechanical model of the æther proposed by Huyghens to account for the propagation of waves of light through it also enabled him to give a simple and satisfactory explanation of why light travels out from the original source in straight lines. Considering the medium which transmits light to be composed of an immense number of very small and very hard spherical particles in close contact with each other, it follows that each of these particles when it is displaced from its position by the passage over it of the parent wave sent out from the original source would itself function as the source of a wave which spreads out from it in all directions. The particular or partial waves of this nature recognized by Huyghens in his argument would be as numerous as the total number of the individual particles of æther contained in a sphere drawn with the source of the primary wave as centre and the distance to which it has travelled out as the radius. It is evident, also, that these partial waves, though present in enormous numbers within the volume of the sphere, would individually be of excessively feeble force. In theory, they are assumed to travel out from their respective centres in all directions but actually, by reason of their excessive feebleness the effect of all the partial waves may be totally ignored except of those which arrive together at the same instant, in other words, *simultaneously*, at the point of observation. For, in the latter case, their effects would be superposed and would add up to give an observable result. Such simultaneity in arrival and consequent superposition of effects would be possible only in the case of those partial waves which originate at points in the medium between the primary source of light and the point of observation which lie on the straight line joining them. The summation of the partial waves originating at such points and

reaching the point of observation at the same instant would produce the luminous effect there observed. Thus the light which reaches the point of observation from the original source may be considered as having travelled out along the straight line joining the two points.

4. THE REFLECTION AND REFRACTION OF LIGHT

In the second and third chapters of his treatise, Huyghens considered the phenomena which arise when light travelling in one medium reaches the boundary which separates it from another. In considering these phenomena, various physical questions arise and are discussed by him, as for example, why some materials are transparent to light and others are opaque, why the velocity of light in a material medium should differ from that in empty space and what the actual configuration of the boundary of the separation between two media is or can be.

The explanation of reflection and refraction in terms of the wave hypothesis is based on an idea which Huyghens found himself compelled to introduce, *viz.*, that the elements of the area of the boundary of separation between the two media act as sources of partial waves which travel out respectively into the two media. The partial waves returned from the boundary into the first medium build up the regularly reflected wave, while those travelling into the second medium give the refracted wave.

A simple geometric construction based on the foregoing ideas enabled Huyghens to explain the familiar law of reflection of light. Likewise assuming the second medium to be transparent and that the velocity of light in it differs from that in the first, a similar geometric construction led him to the result that the sine of the angle of incidence and the sine of the angle of refraction bear to each other a constant ratio which is the same as the ratio of the velocities of light in the two media. The phenomena of total internal reflection of light also found a satisfactory explanation. Huyghens showed further that his construction leads directly to Fermat's principle of minimum time for the passage of light from one point to another when the two points are in different media.

GOLDEN JUBILEE OF THE INDIAN INSTITUTE OF SCIENCE, BANGALORE

THE Golden Jubilee of the Indian Institute of Science, marking its 50 years of progress (1909-59), was celebrated with *eclat* during a week from the 2nd to the 8th February 1959. It was inaugurated by Dr. Rajendra Prasad, President of India, on the 2nd, before a gathering of over 6,000 people. The celebration coincided with the visit to India of His Royal Highness the Duke of Edinburgh and his participation in the inaugural function added importance to it. Among those who took part in the celebrations were His Highness Sri Jayachamaraja Wadiyar, Governor of Mysore, Dr. S. Radhakrishnan, Vice-President of India, Prime Minister Pandit Jawaharlal Nehru and Prof. Humayun Kabir, Union Minister for Scientific Research and Cultural Affairs. A large number of distinguished scientists from abroad, who brought messages of greetings from the scientific organizations of their countries to the Institute on this occasion, attended the celebrations.

President Rajendra Prasad in inaugurating the celebration paid a glowing tribute to the late Mr. J. N. Tata who more than sixty years ago foresaw the requirements of an industrialized India and with forethought, wisdom and patriotism founded this Institute. Speaking about the impact of science on material progress Dr. Rajendra Prasad referred to the dilemma of science and said that science cannot be called a blessing without recognising its social obligations and moral principles, and he stressed on the urgent need of tempering scientific progress with spiritual or moral values.

As Visitor of the Institute, the President announced his approval of the conferment of Honorary Fellowships of the Institute on Prime Minister Nehru, Dr. C. V. Raman and Dr. M. Visvesvaraya.

The Duke of Edinburgh in his speech referred to the crisis which science has produced and said that "we can solve it by our own choice, or, if we don't, it will certainly be solved for us by war or by famine". Speaking on the role of centres of learning, the Duke said, "It seems to me it is the clear duty of all Institutes of higher learning to do what they can to help the world make the right choice".

Earlier, Mr. J. R. D. Tata, President of the Court of the Institute, who presided over the inaugural function, in his welcome speech, recounted the progress of the Institute since its inception and stressed the need for the Institute to identify itself with the task of national reconstruction.

Dr. S. Bhagavantam, Director of the Institute, while proposing a vote of thanks, referred to

the needs of science and technology in India today and made a strong plea for the establishment "in a big way" of an Instrument-making centre in the country.

Prof. Humayun Kabir opened the Golden Jubilee Exhibition, at 4 p.m., on the 2nd February. His Highness the Governor of Mysore opened the New Wind Tunnel of the Aeronautics Department of the Institute on the 3rd February.

Dr. S. Radhakrishnan, Vice-President of India, in his address on the 3rd evening, speaking about Science and Religion, said "Science would help humanity to overcome superstition and ignorance, while religion would help them to overcome selfishness, jealousy and greed. If these two worked hand in hand, the world would have an integrated human being—a being who belonged to the future and not to the present".

Prime Minister Nehru, who addressed a meeting on the 4th February, referred to the problem of conveying scientific knowledge to the people, and to the problem of the language of science which will "not only enable the country to keep pace with the scientific progress abroad but also will help people to develop a scientific way of thinking". He dwelt on the need for a common scientific terminology and said that efforts should be made for evolving a terminology which should be common to all the Indian languages and added that international scientific terms should also be adopted for usage, otherwise it would be impossible for the country to advance in the field of science and technology.

In an evening public lecture on the 4th February, Dr. H. J. Bhabha, Director, Tata Institute of Fundamental Research, spoke on "the Economics and Development Programme of Nuclear Energy for Power Production in our National Plan". In a public lecture, on the 5th evening Dr. K. S. Krishnan, Director of the National Physical Laboratory, spoke on "The Progress of Physics at the Turn of the Century".

There were also a number of scientific and technical lectures arranged in different Departments during the week in which the foreign scientists present addressed scientific gatherings. These included Prof. G. Rienacker (W. Germany), Mr. P. Danel (Holland), Prof. A. Tiselius, N.L. (Sweden), Mr. J. H. Pitchford (England), Dr. A. E. Douglas (Canada), Dr. K. F. Meyer (U.S.A.), Prof. F. Hawking (England), Prof. Hans Friedrich-Freksa (Germany), Dr. Neil Hutcheon (Canada), Prof. L. Janossey (Hungary), Dr. W. T. J. Morgan (England) and Mr. Paul O'Langguth (Bombay).

The Exhibitions arranged by the various Departments of the Institute proved to be of great interest and educative value and daily attracted large crowds of visitors. Originally scheduled to close on the 8th February, they had to be extended for three more days to meet the public demand.

The Golden Jubilee Celebrations have left a deep impression on all those who attended them

and Dr. S. Bhagavantam, Director of the Institute, his staff and students deserve the warmest congratulations for the unqualified success of the celebrations. We have no doubt that with such happy auguries ushering in the new era of the second fifty years, we can confidently look forward to a period of rapid development in the activities of the Institute.

THE INDIAN SCIENCE CONGRESS

THE 46th Annual Session of the Indian Science Congress was held in Delhi from 21st to 28th January 1959 under the auspices of the University of Delhi. The Session was inaugurated by Prime Minister Nehru and was presided over by Dr. A. Lakshmanaswami Mudaliar, Vice-Chancellor of the Madras University. About 3,000 delegates from all over the country and 85 from abroad attended the Session.

His Royal Highness the Duke of Edinburgh who led the British team of delegates to the Congress conveyed greetings and good wishes from the Queen and from the British Association for the Advancement of Science.

In his Inaugural Address the Prime Minister said that "broadly speaking science had driven out many of the Gods before whom people bowed and itself assumed a Godlike pose..... Like two-headed Janus it shows the face of the Creator and the face of the Destroyer". He further remarked that "Science has to look at the heart and mind of man and integrate this knowledge with the other advances it is making".

Dr. Lakshmanaswami Mudaliar in his Presidential Address spoke on the beneficial role

played by modern science in promoting human welfare and, what is more, in preventing human ills, and dwelt in detail about the progress of medicine within the last fifty years and how medical science has been influenced and guided by the great discoveries in physical, biological and technological sciences.

About 1,500 papers contributed to the Session were taken up for presentation in the thirteen sectional meetings each presided over by the Sectional President.

Besides reading of papers there were symposia and public lectures. There were two Exhibitions: The Scientific and Technical Instruments Exhibition and the Exhibition of Scientific Literature in the fourteen Indian Languages. The latter was opened by Mr. C. D. Deshmukh, Chairman of the University Grants Commission. The bulk of the literature represented popular science, school-books and children's literature.

The 47th Session of the Congress will be held in Bombay in January 1960. Prof. P. Parija, Vice-Chancellor of the Utkal University, has taken over as General President for 1959-60.

IRELAND'S TRIBUTE TO HAMILTON, THE DISCOVERER OF QUATERNIONS

A PLAQUE commemorating the discovery of Quaternions by Sir William Rowan Hamilton, the great Irish mathematician, was unveiled at Rowan Hamilton Bridge, formerly Broome Bridge, Cabra, on the 13th November 1958 by the Taoiseach, Mr. de Valera. The story goes that on the 16th October 1843, when Hamilton was walking along the tow path of the Broome Bridge, there suddenly occurred to him the solution of a problem which had been occupying his mind for a considerable time. With a pen-knife he worked out the solution on one of the stones of the bridge. That marked the birth of the quaternions. Paying a tribute to the memory of a great scientist and a great Irishman, Mr. de Valera said, "On many occasions, since I first heard this story well over 50 years ago, I came to this bridge as to a holy place. I have searched stone after stone in the hope

of finding some trace of that famous inscription.Time had done its work but they were gathered there now to see that that inscription would be perpetuated and that those who passed there would remember that they were passing by a spot that was famous in the history of science".

There could be no question of the profound importance of what Hamilton had discovered on that day in October 1843. It was nothing less than a new era of mathematical thought, without which the theoretical development of modern physics would have been well-nigh impossible. As Schroedinger had said "Hardly a day passes, hardly an hour passes, that somebody somewhere on this globe does not pronounce the name of Hamilton, or reads it or writes it or prints it".

INDIAN FISHERIES*

By N. K. PANIKKAR

Fisheries Development Adviser to the Government of India

THE fishery resources of India include marine, estuarine and fresh water fisheries consisting of a very large number of species. Our present sea fish production is of the order of 7 to 8 lakh tons per annum and it is estimated that another 3 lakh tons of fish are produced in inland waters. There is in addition a considerable amount of subsistence fishing. This production is high and places India among the first seven nations having annual production of over a million tons. In 1957 our catch from marine and inland sources totalled about 12 lakh tons which is a very substantial increase over those of previous years. This is, however, inadequate to meet the country's needs which may be roughly computed at about 40 lakh tons per annum. The national income from fisheries is estimated at about 50 crores of rupees per annum and overseas trade in fish and fish products secures for the country about 3 to 5 crores of rupees as foreign exchange.

The sea fisheries resources comprise a large variety of fishes the most important of which are Sardines, Mackerel and Prawns. Many other esteemed varieties exist, particularly pomfrets and seer fish. Fishing is generally confined to the narrow coastal belt of about 6 to 10 miles from the coast and production is in the hands of nearly a million fishermen. Coastal fisheries are largely seasonal which accounts for surplus in some months with the attendant problems of transportation, marketing, processing and storage. The West Coast of India at present accounts for well over two-thirds of our total sea fish production. Exploratory fishing has shown that there are rich deep sea fishing grounds off Kathiawar and extensive prawn resources exist off Bombay and Cochin.

As a result of researches on marine fisheries at the Central Marine Fisheries Station, Mandapam, for the past ten years, we now have a fairly accurate idea of our present sea fish production, important species and regions of the coast where they are found and their seasonal variations. Considerable progress has been made in the study of the biology of important commercial species and in the augmentation of coastal fishery resources by culture and farming practices. Latent resources in sea weeds and

molluscan fisheries have been investigated to give some idea of their value in future development. Basic data on the productivity of the Indian seas, oceanographical conditions and their relation to fisheries are being obtained in an effort to understand and thereby foresee the magnitude and variations of the more important sea fisheries.

The pronounced difference between the West and East Coasts of India in respect of fish landings is associated with the oceanographic conditions prevailing in the Arabian Sea and the Bay of Bengal. The Arabian Sea is an area subjected to continual replenishment of the dissolved nutrients of the surface through the upwelling of deeper waters, the coastal currents and the stress on inshore waters through the strong monsoon winds. There is further a reversal of winds and currents between the South-West and North-East monsoons. Plankton studies have indicated a high degree of productivity in waters off Kerala Coast as compared with the coastal waters of Mandapam and Madras.

The inland fisheries resources consist of the capture fisheries of the large number of rivers, lakes, irrigation dams, etc., and the culture fisheries in the thousands of fish ponds scattered throughout India. Fish cultural practices are particularly developed in Bengal, Bihar and Orissa, where there is an organised fish culture industry. Efforts in inland fisheries development lie in extending fish culture to all parts of India and in the adoption of scientific methods of fish farming. An acre of cultivated fish pond will yield, without artificial feeding, a quantity of about 1000 lb. of fish per acre per annum as against about 200 lb. from fish ponds not subject to cultural practices. Several lakhs of acres of water are now remaining fallow but with effort, all these could be brought to yield a regular harvest.

A major problem here is that the important culture fishes of India, viz., the major carps, Rohu (*Labeo rohita*), Mrigal (*Cirrhina mrigala*) and Catla (*Catla catla*) do not breed in the confined waters where they are cultured. Fish culture industry is, therefore, dependent upon naturally occurring spawn and fry for stocking purposes. As the spawning period is confined to the monsoon months (June-August) and the spawning areas confined to certain portions of rivers or adjoining waters subject to flooding,

* Summary of a public lecture given before the 24th Annual Meeting of the Indian Academy of Sciences, held at Baroda, on 28th December 1958.

the available fish seed is limited. Researches at the Central Inland Fisheries Station have helped to reduce the mortality of fish seed while they are collected and transported. A promising line of work has been successfully opened up whereby the carps have been induced to spawn in the ponds by the administration of pituitary hormone.

The estuarine fisheries mainly consist of capture fisheries in the coastal tracts like Chilka and Pulicat Lakes, large numbers of backwaters on the coasts and estuaries of the large rivers. Important estuarine fishes are Bhukti (*Lates calcarifer*), mullets (*Mugil* spp.), milk fish (*Chanos chanos*) and prawns.

A large part of our sea fish catches is seasonal and based on shoaling species like Sardines and Mackerel. This fact combined with the inadequacy of transportational facilities to send fish in fresh condition to the interior, has led to the development of a fish curing industry. The surplus catches are either sun-dried or salt cured and later sun-dried. Prawns are often boiled and sun-dried. Pit-curing and wet-curing

by different methods are also practised throughout India, but the curing industry is best developed on the Kanara, Konkan and Malabar coasts. Recently, cold storage and ice plants have been established in various places and private industry has come into the field of freezing good quality prawns and fish. The bulk of cured fish produced in India is exported to Ceylon and other eastern countries and there is a growing market for frozen shrimp in the United States. In addition, small quantities of fish meal, fish guano, fish manure and fish oil have been exported to other countries for many years.

Fisheries have been looked upon for many years only as a source of revenue. It took many years to have that orientated to development and better utilisation of an important natural resource. In recent years administrative organisations to deal with fisheries have come into being in most States but much more remains to be accomplished if fishery industry is to contribute its full share to national economy.

SOME ASPECTS OF ESTUARINE HYDROLOGY AND BIOLOGY*

ESTUARIES are characterised by complexity of physical structure and pattern of circulation and ever-unsettled hydrological features. Studies of the vellar estuary (Lat. 11°29' N and Long. 79°49' E) which is a bar-built estuary and always open to the sea show that it can be demarcated into (1) a *marine zone* with homogeneous salinity, (2) a *tidal zone* with higher salinity at the bottom and lower salinity at the surface, and with the difference between the bottom and surface salinities progressively increasing up the estuary and (3) a *gradient zone* with the difference in salinity progressively diminishing up the estuary, and which merges into (4) the *freshwater zone*. The existence of a stratification into an upper less saline and a lower more saline layer in this bar-built estuary makes it difficult to fit it into the generally accepted schemes of classification of estuaries. There is need for critical studies of the hydrography of Indian estuaries.

The salinity of estuarine waters is continually changing. Hourly and two-hourly studies of the

hydrobiology of the vellar estuary have been continuously made for twenty-four hours of full-moon and new-moon days. The rate of change of salinity is not uniform but varies frequently in a marked manner during the flow as well as ebb tides. This is much more marked at the surface than at the bottom. The differential rate of the continual change of salinity is very significant for organisms in relation to their physiological adaptations and distribution in the different zones of the estuary.

The dynamic state of estuarine waters is also reflected in the fluctuations in the volume and composition of plankton from hour to hour. The volume of plankton collected has its maximum during night time at low tide.

Estuarine organisms are very suitable for comparative biochemical studies. Biochemical features of the gonadal cycles of estuarine fish have been under investigation in comparison with those in other environments. The pituitary and ovary during different stages show interesting variations in their biochemical constituents like free and protein bound amino acids, amino nitrogen, alkaline phosphatase, etc.

* Summary of paper presented to the 24th Annual Session of the Indian Academy of Sciences, Baroda.

CYTO-GEOGRAPHY OF SOME INDIAN PLANTS*

THE Plant Geographer is concerned not only with the distribution of plants in Space but also in Time. The primary cause of changes in the distribution of plants seen in the present day, lies in the variation in the distribution of climates. This again is closely related to the changes in the distribution of land and water brought about by cycles of mountain building and the Ice Ages which have always followed these revolutions.

The breaking up of the great Gondwana land and the Himalayan uplift took place after the evolution of Flowering plants. This has resulted in the dispersion of related families and genera in the continents of South America, Africa, Australia and Peninsular India, all of which formed part of this great land system.

The analysis of some genera of Indian plants has been correlated with the performance of allied plants in these regions. For this study, chromosome changes and polyploidy have been used as a measure of genetic advance. In such

genera as *Magnolia* and *Viburnum*, the North Asian tribes which are all diploids, have undergone evolutionary changes resulting in new polyploid species in Eastern Himalayas.

The diploid *Nymphæa stellata* of Kerala is closely related to the *Nymphæa* of Madagascar and East Africa while the same species occur only as hexaploids in the Gangetic Plain. Hexaploids are also found in Egyptian and European species of *Nymphæa*.

The genus *Buddleia* probably arose in Africa where only diploids ($2n = 38$) are found in this genus and allied genera. Amongst Indian species, very high polyploids ($2n = 114$, $2n = 304$) occur in Sikkim and Assam regions.

Some of the trees belonging to Magnoliaceæ which have been identified with fossils are found to be diploids. They may therefore be considered to have remained diploids since their first appearance on the earth! This is true also of some of the *gigantic trees of the Humid Tropics of India*. We therefore, have in these regions, a vegetation which is similar to what existed on the earth during Cretaceous times.

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* Summary of a lecture delivered at the 24th Annual Meeting of the Indian Academy of Sciences, held at Baroda, on 29th December 1958.

THE 2-METER-PLANO GRATING SPECTROGRAPH

THE first German grating spectrograph (Fig. 1) uses a Zeiss-original grating of the best resolution with 650 ruled lines per mm. on a divided area of 70×50 mm. The advantage of the chosen Ebert set-up is the stigmatic,

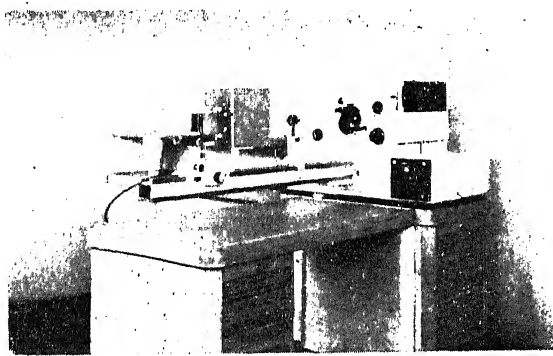


FIG. 1

nearly plane image of the spectra. The dispersion is 7.4 \AA/mm. in the first order at a theoretic resolution of 45000, which is nearly obtained. At an opening proportion 1:30 the spectral range from 2000 to 28000 \AA is covered

in cut-outs of 1750 \AA on the fixed plate of the length 240 mm., and in cut-outs of 2200 \AA on the fixed plate of the length 300 mm. The Grating Spectrograph particularly excels in that a wavelength scale within the range of $2000\text{--}7000 \text{ \AA}$ of the first order may be copied. The shutter and the dark slide displacement adjustable in stages are operated automatically. It is possible to connect a time switching appliance. A novel and extraordinarily stable square rail takes up the spark gap and the condenser optics.

The device is mounted on a special table and embodies exacting optical performances as well as a finished appearance.

The gratings used have saw-toothed profile of the ruled lines. The "Blaze" properties are within the ultra-violet and visible of the first order with a degree of reflexation of about 70%. The relative intensity of the very weak Rowland reflexions is below 0.1% of the main line in the first order. Since the grating, may be screwed for reading within the range of $\pm 65^\circ$, exposures of the higher order may easily be taken after the tabular adjustment of the grating.—VEB CARL ZEISS JENA.

STORED ENERGY IN THE GRAPHITE OF A NUCLEAR REACTOR

THE annealing of nuclear reactors to release their "stored energy" has come into the news during the past year because it was during such a release, last autumn at Windscale that an accident occurred.

What is stored energy? And how and why is it released? To answer such questions we must start with the way that a nuclear reactor works. When a uranium-235 nucleus explodes, in the process of nuclear fission, most of the energy that it releases appears as energy of motion in the pieces of the nucleus that are thrown apart by the explosion. The main pieces quickly come to rest within the fuel material itself and their energy is turned into heat. But the two or three neutrons that are also thrown off travel much farther and escape out of the fuel into the surrounding material. It is necessary to place a special substance, the "moderator", between the fuel rods to slow them down.

The moderator consists of a solid stack of large graphite blocks through which pass channels for fuel rods and cooling gas. Inside this graphite a neutron makes an irregular zigzag journey, bouncing once every few centimetres or so off the nucleus of a carbon atom that it happens to meet. Although carbon atoms are strongly held together in graphite by the forces of atomic bonding, the impact of a fast neutron on such an atom is so severe that it not only knocks the atom away from its neighbours, it also gives this atom enough energy to push its way past many other atoms and to knock about 100 others out of place before it is brought to rest again.

If they were in a liquid the displaced atoms could easily make new places for themselves amongst the general irregular swirl of atoms, by pushing others aside. But graphite is a solid, made of crystals in which the carbon atoms are regularly arranged in a hexagonal pattern in sheets stacked one on top of another. If an atom is removed from its place in this pattern, its neighbours remain in their places and an atomic-sized hole, called a "vacancy", is left in the crystal. The crystal pattern is then no longer perfect, and is said instead to be "defective". Conversely, when a displaced atom comes to rest at a place in the crystal where there is no vacancy it cannot become part of the pattern and must intrude itself into some position between the hexagonal sheets;

this type of defect in the crystal is called an "interstitial". Professor E. P. Wigner of Princeton University, predicted that these vacancies and interstitials would change the properties of the material, perhaps adversely. These changes are now known to occur and are called "Wigner effects". Some of them are fairly obvious. Mechanical strength and hardness are certainly changed by such defects in a crystal; and interstitials change the shape of graphite by pushing the hexagonal sheets apart slightly.

Most of the energy lost by a fast neutron in graphite is immediately turned into heat but some of it remains "stored" in the vacancies and interstitials. When an atom is knocked out of place some energy is required to sever the atomic bonds which held it to its neighbours and some is required to strain the hexagonal sheets apart to make room locally for the interstitial. This energy is stored in the sense that so long as the vacancies and interstitials remain in the crystal, it remains with them and cannot be turned into heat. The amount of energy that can be stored in graphite in this way is surprisingly large, in extreme cases as much as one-sixteenth of the energy that would be released by burning the material. This is because the energy required to place an atom of the crystal pattern into an interstitial position is not far short of that required to evaporate it away from the crystal altogether. In fact, if all the energy stored in 1% of displaced atoms could be turned into heat it would be enough to increase the temperature of graphite by more than 500° C.

It is the possibility that a sudden and large increase of temperature might take place, which could lead to excessive oxidation of the graphite and also cause damage to the fuel and other materials in the reactor, that has made stored energy an important problem in graphite-moderated reactors.

There are three general ways to deal with the stored energy problem in graphite reactors; to keep the graphite hot during running so as to avoid storing much energy; to allow the graphite to store energy but control its temperature so that a release of energy can never occur; or to allow the graphite to store energy but deliberately release this energy at intervals so as to avoid high temperatures.—*Times Science Review*, Autumn 1958.

EFFECT OF CERTAIN ORGANIC INSECTICIDES ON THE YIELD OF CROPS

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THE reaction of plant to the application of modern insecticides, independent of the role of the latter in controlling insect infestations, does not appear to have received adequate attention. Insecticides can affect plants in two ways; they may prove beneficial, by absorption into the system and stimulate growth, resulting in a better stand and increased yields. It has been claimed for several recent formulations that they serve as hormones in promoting growth and output of crops in addition to their more legitimate function of controlling insect pests. The second possibility is that insecticides may prove harmful to the plants, by retarding growth, causing malformations, reducing yields and so on. Much attention has been bestowed on this aspect under the broad heading 'Phytotoxicity'. Scorching, wilting, malformation, unhealthy colour and appearance, premature leaf-fall and lowered yields, are some of the obvious symptoms of Phytotoxicity. Similarly, tainting, insipidity, off-flavours, unpleasant taste, etc., are some of the manifestations when such insecticides are absorbed, translocated, and stored in the plant body. The third obvious possibility is for the concerned insecticide to have no effect on the plant, except to kill or repel insect populations.

In order to determine one particular aspect of this question, viz., the effect of insecticidal treatment on the yield of the crop, a series of small-scale field trials were laid out. Small plots put under a particular crop, were sprayed with normal strengths of the selected insecticides, at definite intervals, which were shorter than are prescribed in spraying schedules. Spraying was carried on without reference to insect attack, and in fact, in most trials no insect infestation was noticed. A check plot with no treatment was maintained in each case.

The relevant data concerning the various trials are briefly furnished in the table (Series I).

Remarks.—Though 30 pieces were planted in each sub-plot a varied number of plants were killed by root grubs in the soil. A number of tubers were also seen damaged by root grubs which in some cases were found actually gnawing tubers at harvest. The weights of damaged tubers shown above are only those of the portions remaining.

SERIES I

Crop:—Potato; *Sub-plot size:*—7' × 4½'.
Planted:—7-6-1958; *Harvested:*—21-8-1958.
Insecticides:—(a) DDT 50% w.p.—1 lb. in 16 gallons
(b) Folidol—3 c.c. per gallon.
No. of treatments:—9; *Frequency:*—Weekly.

Harvest Results :—

Treatment	No. of plants	No. of Tubers		Weight of Tubers		
		Good	Damaged	Good (g.)	Damaged (g.)	Total (g.)
DDT ..	30	52	8	1327	146	1473
Folidol ..	18	29	6	460	137	597
Check ..	16	27	19	156	260	416

SERIES II

Crop:—Groundnut; *Sub-plot size:*—256 sq. yds.
Sown:—28-7-1958; *Harvested:*—26-11-1958
Insecticides:—(a) DDT 50% w.p.—1 lb. in 16 gallons
(b) Heptachlor—10 c.c. per gallon
(c) Folidol 2 c.c. do.
(d) Endrex 9 c.c. do.
(e) Basudin 10 c.c. do.
(f) Aldrin 10 c.c. do.

No. of treatments:—5; *Frequency:*—Fortnightly.

Harvest Results :—

Treatment	Weight of pods harvested lb.	Variation from check	By measure (in Mysore seers)	Variation from check
DDT ..	31	-17	20	-11
Heptachlor ..	53	+ 5	34	+ 4
Folidol ..	53	+ 5	35	+ 5
Endrex ..	53	+ 5	35	+ 5
Basudin ..	55	+ 7	34	+ 4
Aldrin ..	13	-35	10	-20
Check ..	48	..	30	..
Average of 4 other bits treated as check	23	..	16	..

Remarks.—The plot is not level, but sloping from West to East with a conspicuous hump in the portion where (e) and (f) sub-plots are located,

SERIES III

Crop:—Potato; *Sub-plot size*:— $6\frac{1}{2}' \times 6'$.
Planted:—6-8-1958; *Harvested*:—7-11-1958.
Insecticides:—Heptachlor—6 c.c. per gallon.
No. of treatment:—10; *Frequency*:—Weekly.

Harvest Results :—

Treatment	No. of pieces planted	No. of tubers	Weight (g)
Heptachlor	.. 54	52	438.5
Check	.. 35	39	264.0

SERIES IV

Crop:—Cabbage.
Sown:—21-7-1958; *Transplanted*:—8-8-1958 and 11-8-1958; *Harvested*:—18-11-1958.
Insecticides:—(a) DDT 50% w.p. — 1 lb. in 16 gallons.
 (b) Folidol—3 c.c. per gallon.
No. of treatments:—14; *Frequency*:—Weekly.

Harvest Results :—

Treatment	Sub-plot size	No. of plants	No. of heads formed	Total weight including roots
DDT	.. $8' \times 6\frac{1}{2}'$	16	Nil	2.4 Kg.
Folidol	.. $8' \times 7\frac{1}{2}'$	16	5	7.2 Kg.
Check	.. $8' \times 3'$	11	Nil	0.8 Kg.

Remarks.—There is some variation in the size of the sub-plots. Due to root grub trouble in the soil, a number of plants died in the early stages. At harvest, heads had been formed only in the Folidol plot.

SERIES V

Crop:—Garden beans; *Sub-plot size*:— $7' \times 4\frac{1}{2}'$.
Sown:—23-10-1958; *Harvested*:—10, 20, 27-12-1958 and 3-1-1959.
Insecticides:—(a) DDT 50% w.p.—1 lb in. 16 gallons,
 (b) Folidol—3 c.c. per gallon.
No. of treatments:—8; *Frequency*:—Weekly.

Harvest Results :—

Treatment	No. of plants	No. of pods	Weight of pods (g.)
DDT	.. 31	349	1254
Folidol	.. 33	344	1245
Check	.. 29	477	1783

Remarks.—The check plot shows more luxuriant and healthy foliage than either of the treated plots. DDT plot particularly looks off-colour, with top-leaves wrinkled at the edges.

DISCUSSION

It is apparent that in these trials, insecticidal treatment has had a recognizable effect, beneficial or adverse, on the yield. Where the effect

is beneficial, it is distinct from the advantage accruing to the plants on account of insect infestation being controlled, since there was no infestation in these trials. The reaction of the plants to the insecticide is seen in an exaggerated measure due to the greater frequency of application and perhaps higher strengths of insecticides sprayed.

In the above trials DDT and Folidol were employed in four series,—on Potato, Groundnut, Cabbage and Garden beans. On the first three crops both the pesticides have resulted in increased yields, compared to the controls. On Potato, the average yield per surviving plant is 44.2 g. (DDT), 25.5 g. (Folidol) and 9.75 g. (Control); average number of tubers per plant is 2 (DDT and Folidol) and 3 (Control); average weight of a good tuber is 25.5 g (DDT); 16 g. (Folidol) and 5.8 g. (Control); and percentage of tubers damaged by root grubs is 13.3 (DDT), 17 (Folidol) and 43.4 (Control). Thus not only is the yield (by weight) proportionately more, but the incidence of the root grub is less, under treatment. On groundnut, while the yield of the DDT plot is less than in the check plot, it is greater than the average of the untreated portions. Folidol has given a yield much higher than the two controls. On cabbage the average weight of each plant at harvest is 150 g. (DDT), 450 g (Folidol) and 72.7 g. (Control).

On Garden beans the results are contrary. The number of pods harvested per plant and their weight was less under treatment than in the check. Thus the average number of pods per surviving plant is 11.2 (DDT), 10. (Folidol) and 16.4 (Control); weight of pods harvested per plant is 40.4 g. (DDT), 37.7 g (Folidol) and 61.5 g. (Control).

Heptachlor was sprayed on groundnut and Potato and gave better yield than the control. On Potato while the number of tubers per plant is one, the weight of yield, per plant is 8.43 g. (Heptachlor) and 6.77 g. (Control). On groundnut the yield was substantially higher under treatment compared both to the check plot and the untreated portions.

Endrex, Basudin and Aldrin were tried only on groundnut. The first two pesticides gave better results than both the check and the untreated portions. The performance of Aldrin was however conspicuously poor, but this requires confirmation by further tests.

Grateful thanks are due to Dr. M. Puttaturdiah, Government Entomologist, for encouragement and helpful advice, and to Messrs D. P. Ramanna and S. Nanjunda Sastry for their assistance in fieldwork.

LETTERS TO THE EDITOR

EVALUATION OF FORCE CONSTANTS OF OsO_4

WOODWARD and Roberts¹ have recorded the Raman spectra of OsO_4 . Using the simple valence force field, without interaction terms, they have evaluated the force constant for X-Y stretch.

Using the Wilson's F-G matrix method, the secular equations have been obtained, and five force constants have been evaluated for the molecule OsO_4 .

The molecule under investigation has the point group T_d . As such by the application of group theoretical methods and the relevant selection rules such a structure yields 1 non-degenerate vibration of type A_1 , 1 doubly degenerate vibration of type E, and 2 triply degenerate vibrations of type F_2 . All the vibrations are Raman active.

The most general second-degree potential energy function used in this investigation is given below. It is not possible to give values for all the force constants since only four fundamental frequencies are available.

$$2V = f_d \sum_i \Delta d_i^2 + f_a \sum_{i,j} (d \Delta \alpha_{ij})^2 + f_{da} \sum_{i,j} \Delta d_i \Delta d_j \\ + 2f_{aa} \sum_{i,j} (d \Delta \alpha_{ij}) (\sum_{k,l} d \Delta \alpha_{kl}) \\ + 2f_{aa'} \sum_{i,j,m,n} (d \Delta \alpha_{ij}) (d \Delta \alpha_{mn}) \\ + 2f_{da} \sum_{i,j} \Delta d_i [\sum_{k,l} (d \Delta \alpha_{kl})] \\ + 2f_{da'} \sum_{i,j,k} \Delta d_i \sum_{j,k} (d \Delta \alpha_{jk})$$

where $ij = 1, \dots, 4$ and $i \neq j$

$k, l = 1, \dots, 4$ but k or l may be equal to i or j and $i = j$.

Similarly $m = n$ but m or n may be equal to i or j .

The subscripts d and a denote bond stretching and bond bending for the force constants and dd , da and aa indicate bond-bond, bond-angle and angle-angle interactions respectively.

The secular equations for the three types of vibrations are

For A_1

$$\lambda_1 = F_{11} G_{11} = (f_d + 3f_{dd}) \mu_y \quad (1)$$

For E

$$\lambda_2 = F_{11} G_{11} = \frac{d^2 (f_a - 2f_{aa})}{d^2} 3\mu_y \quad (2)$$

For F_2

$$\lambda^2 - \lambda \left[f_a \left(2\mu_y + \frac{16}{3} \mu_x \right) - \frac{16 \sqrt{2} \mu_y f_{da}}{3} \right. \\ \left. + (f_d - f_{dd}) \left(\mu_y + \frac{4}{3} \mu_x \right) \right]$$

$$+ [(f_d - f_{dd}) f_a - 2f_{da}^2] \\ + \left[\left(\mu_y + \frac{4}{3} \mu_x \right) \left(2\mu_y + \frac{16}{3} \mu_x - \frac{64 \mu_x^2}{9} \right) \right] \quad (3)$$

The values of μ used are

$$\mu_{os} = 3.166 \times 10^{21} \text{ gm.}^{-1} \\ \mu_o = 3.764 \times 10^{22} \text{ gm.}^{-1}$$

The Raman frequencies in cm.^{-1} of the molecule reported by Woodward and Roberts and their assignments on the basis of polarization characters are given below:

OsO_4	$\nu_1 (A_1)$	..	965	$\nu_3 (F_2)$	..	954
	$\nu_2 (E)$	..	335	$\nu_4 (F_2)$	..	335

By taking into consideration the bond-bond interaction constant the following secular equations are obtained:

$$f_d + 3f_{dd} = 8.785 \times 10^5 \\ 9.216f_a - 2.408f_{da} + 4.18(f_d - f_{dd}) \\ = 36.3 \times 10^5 \\ (f_d - f_{dd}) f_a - 2f_{da}^2 = 3.4 \times 10^{10}.$$

Eliminating f_a from the last two equations, the quadratic so obtained in f_{da} gives two real roots for the values of $(f_d - f_{dd})$ ranging from 0.9×10^5 to 7.882×10^5 . The maximum value of 7.882×10^5 has been chosen as it gives the ratio f_{da}/f_d minimum and the value of f_d so obtained is nearer the value of f_d obtained by the simple valence force field treatment. The force constants thus obtained are listed below and are a unique set, because the quadratic in f_{da} yields real and coincident values for the particular value of $f_d - f_{dd} = 7.882 \times 10^5$.

The force constants in dynes/cm.

f	$f \times 10^{-5}$
f_d	.. 8.10750
f_a	.. 0.49 00
f_{da}	.. 0.51475
f_{dd}	.. 0.22575
f_{aa}	.. 0.14580

Woodward's value for f_d using the valence force field treatment ignoring bond-bond interaction is 8.77×10^5 dynes/cm.

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THE UNCERTAINTY PRINCIPLE AND RUTHERFORD SCATTERING

IN scientific literature we come across many examples of Heisenberg's Principle of Uncertainty which serve to elucidate and provide insight into the fundamental laws of quantum mechanics.* The present note deals with the use of Rutherford Scattering as an "ideal instrument" for the measurement of velocity.

Consider the case of an α -particle scattered through an angle 2θ by the nucleus N (Fig. 1). We have:

$$\tan \theta = \frac{ZeE}{Mv^2} \cdot \frac{1}{b} \quad (1)$$

where the symbols have their usual meaning. If we measure θ , we can determine the velocity v , by assuming the other quantities as known.

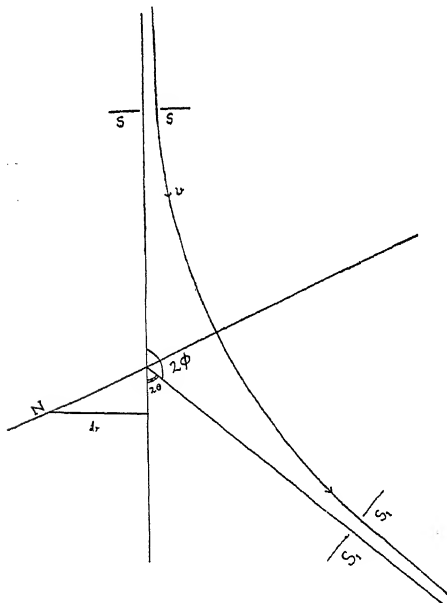


FIG. 1

Writing Mv equal to the momentum p and differentiating, we obtain

$$\frac{\sec^2 \theta}{\tan \theta} \Delta \phi = \frac{2 \Delta p}{p}$$

or
$$\frac{\Delta \phi}{\sin 2\theta} = \frac{\Delta p}{p} \quad (2)$$

If d is the width of the slits SS and S_1S_1 and L the distance between them, the inaccuracy in the measurement of the angle of scattering will be

$$\delta \phi \geq \frac{\lambda}{d} \quad (3a)$$

$$\text{where } \lambda = \frac{h}{p}$$

$$\text{and also } \delta \phi \geq \frac{d}{L} \quad (3b)$$

The equation (3a) results from the diffraction of the de Broglie wave in passing through the slit and equation (3b) expresses the error inherent in the geometry of the experiment. We have then,

$$(\delta \phi)^2 \geq \frac{\lambda}{L} \quad (4)$$

The uncertainty Δq in the position of the particle along the path SS_1 cannot be less than the product of the uncertainty in its velocity and the time it takes to go through the apparatus, that is

$$\Delta q \geq \frac{\Delta p}{M} \cdot \frac{L}{v} = L \frac{\Delta p}{p} \quad (5)$$

Multiplying (5) by Δp and using (2), we have

$$\Delta q \cdot \Delta p \geq \frac{L (\Delta p)^2}{p} = \frac{(\Delta \phi)^2}{(\sin 2\theta)^2} L p \quad (6)$$

Inserting the relation (4), we get

$$\Delta q \cdot \Delta p \geq \frac{\lambda p}{(\sin 2\theta)^2} \geq h$$

as $\sin 2\theta \leq 1$

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VARIATION OF HUGGIN'S CONSTANT WITH SOLVENT POWER FOR POLYMETHYL METHACRYLATE SOLUTIONS

THE Huggin's equation for the viscosity number can be written as

$$\frac{\eta_{sp}}{c} = [\eta] + k' [\eta]^2 c \quad (1)$$

where η_{sp}/c is the viscosity number, $[\eta]$ is the intrinsic viscosity, c is the concentration and k' is a constant (Huggin's). Recently this constant k' received increasing attention, both theoretically and experimentally. Even though there is some doubt as to the exact significance of the constant, it can be used as a measure of relative effectiveness of various solvents for a given polymer. It was shown by several workers¹⁻⁴ that the value of k' varies systematically with the solvent power for the same polymer sample. Eirich and Riseman² theoretically predicted a relationship between $[\eta]$ and k' as follows

$$k' [\eta]^2 = \alpha + \sigma [\eta] \quad (2)$$

where α and σ are constants. Bhatnagar *et al.*⁵ on the basis of the 'theory of rate process' using

* Heisenberg, W., *The Physical Principles of Quantum Theory*, Chicago University Press; Darwin, C. G., *Proc. Roy. Soc.*, 1930, 130A, 632; Kothari, D. S., *Phil. Mag.*, 1939, 2, 62.

an equivalent sphere model arrived at a similar relation. They further showed that

$$\alpha = -\frac{\sigma^2}{2} \quad (3)$$

There is no sufficient data except that from Streer and Boyer⁴ on polystyrene to verify this equation, because the shear effects will be more for high molecular weight fractions. With the data that are available with us in connection with our work on light scattering and viscosity studies of polymer solutions it is possible to verify the above equation. For a polymethyl methacrylate sample of molecular weight about 404,000 the rate of shear effects will be negligible in a number of solvents. The adsorption effects⁶ are also negligible in this concentration range (0.1 to 0.3 gm./100 ml.). Intrinsic viscosities were calculated by drawing η_{sp}/c and $\log \eta_r/c$ against c on the same graph and extrapolating to $c=0$. It provides a certain check on the extrapolation.

TABLE I

Solvent	$[\eta]$	$[\eta]^2$	k'
1 Chloroform	1.28	0.55	0.337
2 Pyridine	1.20	0.275	0.193
3 Benzene	1.02	0.115	0.371
4 Diethyl ketone	0.745	0.250	0.450
5 Methyl ethyl ketone	0.749	0.250	0.457
6 Acetone	0.708	0.270	0.459
7 Ethyl acetate	0.668	0.210	0.471
8 Normal amyl acetate	0.376	0.070	0.445

The value of k' was determined in eight solvents and the results are shown in Table I. It is clear that the values of k' are increasing

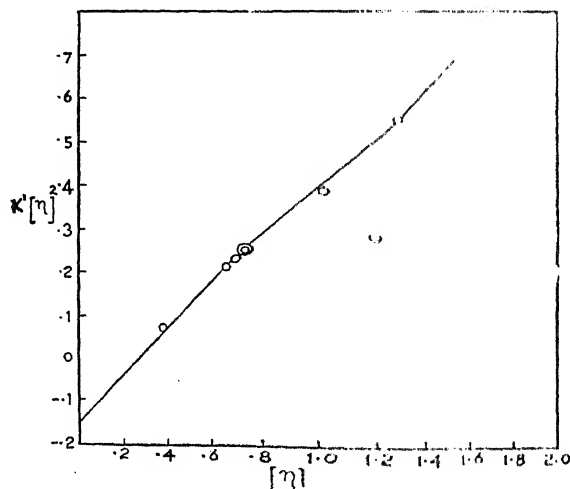


FIG. 1. Relation between $k' [\eta]^2$ and $[\eta]$ for a P.M.M. fraction ($M_v = 404 \times 10^6$) in various solvents.

with decreasing solvent power, a property which was already established.^{1,4} A graph is plotted between $k' [\eta]^2$ and $[\eta]$ as shown in Fig. 1. Except for pyridine all the other points have almost fallen on the straight line. In the case of pyridine the point deviates much from the straight line graph beyond the experimental error.

The slope and intercept give the values of σ and α . We obtain the value of 0.54 for σ and 0.15 for α . These values also satisfy relation 3.

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DETERMINATION OF INTERNUCLEAR DISTANCE IN DI-ATOMIC MOLECULES FROM THE INTENSITY OF VIBRATIONAL BANDS

The intensity of a band belonging to a given electronic transition is proportional to the overlap integral $\int \psi_i \psi_f dx$, to a first approximation, neglecting the variation of electronic transition moment¹. Numerous methods have been developed for the evaluation of the overlap integral to calculate the relative intensities of vibrational bands belonging to a particular system.

Analytical expressions for the overlap integral which can be conveniently handled are available under Simple Harmonic approximation due to Hutchisson,² and Manneback.³ Similarly in the Morse Oscillator approximation, convenient expressions have been developed by Jarman and Fraser.^{4,5} Both these expressions contain as parameter, $r_e'' - r_e'$, where r_e' and r_e'' are the equilibrium internuclear distances for the initial and final states.

While attempting to test the relative merit of the above expressions, by applying them to calculate the relative intensities of vibrational bands of some diatomic molecules appreciable discrepancies were observed. Thus, using Hutchisson's and Manneback's method, it was found that for certain system of bands for

instance Na_2 ultraviolet bands $c'\Sigma_u^+ \leftrightarrow X'\Sigma_g^+ -$ the calculated intensity distribution was widely different from the observed ones. It became easily discernible that the calculated intensity distribution pattern was highly sensitive to the value of $r_e' - r_e''$ —(this difference will be denoted by Δr_e in this paper)—and if one of these quantities was not accurately known the theoretical intensity pattern will be altogether different from the observed one. On investigation the Fraser and Jarman expression for the overlap integral was also found to be quite sensitive (although not to the same extent) to variation in Δr_e . It is found that for small variation in Δr_e the calculated relative intensity shows linear variation.

Impressed by the sensitiveness of these expressions to Δr_e values it was considered worthwhile to reverse the process and to use the pre-

The actual value of Δr_e will lie close to it. A set of values for Δr_e differing by small amounts were then selected and the intensities of all the bands whose v' and $v'' \leq 2$ were calculated relative to (0, 0) band, using Fraser and Jarman method. From these values the ratios $p(0, 1)/p(0, 0)$; $p(0, 2)/p(0, 0)$; $p(1, 1)/p(1, 0)$, etc., were found out for each value of Δr_e and a graph (relative intensity vs. Δr_e) was drawn for each case. From these graphs the value of Δr_e corresponding to the experimentally observed value of intensity was read out.

The value of Δr_e thus obtained for the above band systems showed small scatter about the mean value which in all cases agreed with the accepted value to a fairly high degree of accuracy.

The results are shown below.

C_2 Swan		N_2 Second positive		CN violet	
Bands whose intensities were compared	Estimated $r_e' - r_e''$	Bands whose intensities were compared	Estimated $r_e' - r_e''$	Bands whose intensities were compared	Estimated $r_e' - r_e''$
(2, 0), (2, 2)	0.0441	(2, 0), (2, 1)	0.0614	(0, 1), (0, 0)	0.0218
(2, 2), (2, 1)	0.0430	(1, 2), (1, 0)	0.0688	(1, 0), (1, 2)	0.0231
(2, 0), (2, 1)	0.0474	(2, 2), (2, 1)	0.0616	(1, 0), (1, 1)	0.0202
(1, 0), (1, 2)	0.0405	(2, 2), (2, 0)	0.0636	(1, 2), (1, 1)	0.0197
(1, 1), (1, 2)	0.0493	(1, 2), (1, 1)	0.0598	(2, 1), (2, 2)	0.0202
(1, 0), (1, 1)	0.0450	(0, 2), (0, 0)	0.0637		
(0, 2), (0, 0)	0.0410	(1, 1), (1, 0)	0.0623	Average ..	0.0210
(0, 1), (0, 0)	0.0393	(0, 1), (0, 0)	0.0646	Accepted value *	0.0212
		(0, 2), (0, 1)	0.0668		
Average ..	0.0437	Average ..	0.0638		
Accepted value *	0.0457	Accepted value *	0.0641		

* Accepted values are from Herzberg.¹

cise microphotometrically measured intensity data for an accurate calculation of Δr_e . In that case if one of the two quantities, r_e' or r_e'' is known from rotational analysis or from X-ray or Electron diffraction work, then the other can be calculated without going in for rotational analysis.

To test the possibility of the above method, three well established band systems were selected:—CN violet $B^2\Sigma \rightarrow X^2\Sigma$ system; N_2 second positive $C^3\pi \rightarrow B^3\pi$ system and C_2 Swan $A^3\pi \rightarrow X^3\pi$ system. Experimental intensity data as well as r_e values in both the states are accurately known for these systems. First of all a provisional value of Δr_e is obtained using the ratio of intensities of (0, 0) and (0, 1) bands and Manneback expression for $p(0, 0)/p(0, 1)$.

The above method thus provides a new and accurate method, not involving rotational analysis for the determination of r_e value for an electronic state of a molecule provided this state combines with another electronic state of known r_e value.

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ANODIC OXIDATION OF MANGANOUS SULPHATE IN AQUEOUS SULPHURIC ACID

WHILE investigating the various electrochemical factors involved in the anodic oxidation of toluene to benzaldehyde, it was observed that the yield of benzaldehyde depends upon the formation of manganic sulphate from manganous sulphate which has been used as an "oxygen carrier". It was thus considered worthwhile investigating the optimum conditions for the formation of manganic sulphate in aqueous sulphuric acid using lead anode.

Extensive investigations have been carried out by earlier workers on the electrolytic oxidation of manganous sulphate.¹⁻⁴ These have been done mostly with platinum anodes. Lang,² however, employed a lead-lined cell, the cell itself being used as anode. These investigators all employed only clear solutions of manganous sulphate in sulphuric acid. Solanki *et al.*³ reported about 70% current efficiency. In the present work two sets of experiments were done, one using a clear solution of 28 g. of manganous sulphate in 700 c.c. of 55% sulphuric acid, and the second using a suspension of 200 g. of exsiccated manganous sulphate⁵ in 700 c.c. of 55% sulphuric acid. The experiments were carried out in a cylindrical glass beaker. Two lead cathodes, each 5×17.4 mm. were employed on either side of a cylindrical lead anode with an effective area of 1.2 sq. dm. The electrolyte was agitated by an electrical stirrer, when the anode used was stationary.

The current efficiency was determined after electrolysis, by adding a definite volume of the electrolyte or a known weight of the paste, to a known excess of ferrous sulphate solution and titrating the excess of ferrous ion against standard permanganate. The current efficiency was found to be 75% with a stationary anode. Rotating the anode increased the current efficiency slightly, but changing the interelectrode distance did not influence the same. Anodes of lead, antimonial lead and lead dioxide, all gave the same satisfactory results. Anode potentials above 1.8 volts (hydrogen scale) diminished current efficiency. Separating the anode chamber from the cathodes did not affect current efficiency appreciably, indicating that trivalent manganese is not cathodically reduced, much under the experimental conditions employed. In the case of suspended manganous sulphate, it was possible to convert the whole of it, by passing enough current, into a paste of manganic sulphate.

Fuller details of the investigation will be published elsewhere.

The authors express their sincere thanks to Dr. K. S. G. Doss, Director of the Institute for his keen interest in the investigation.

M. S. VENKATACHALAPATHY.
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ION-EXCHANGE SEPARATION OF LIGHT RARE EARTHS USING SODIUM TRIPOLYPHOSPHATE

WELL KNOWN eluants used in the ion-exchange separation of rare earths by complexing elution are organic complexing agents¹⁻⁷ such as citric, tartaric, lactic, nitrilo-triacetic and ethylene-diamine-tetraacetic acids. The condensed alkali phosphates, which form an important class of inorganic sequestering agents, do not appear to have been much studied for these separations. The feasibility of using sodium tripolyphosphate as eluting agent for the purpose is under investigation in this Laboratory.

Preliminary experiments on the distribution of the rare earth tripolyphosphate complexes between the solution phase and a strongly basic anion exchanger, Amberlite IRA 400, have indicated that these complexes are anionic and stable in the pH range 2-10.

Elution with 0.3-0.5% w/v sodium tripolyphosphate solution of a mixture of La^{+++} , Pr^{+++} , Nd^{+++} and Sm^{+++} adsorbed in a narrow band on the top of a cation exchanger (Dowex 50) column has given us varying degrees of fractionation depending upon the pH and concentration of the eluant. Particulars of one typical elution experiment are given below:

A rare earth mixture (20% La_2O_3 , 13% Pr_2O_3 , 59% Nd_2O_3 , 8% Sm_2O_3 , total load 940 mg. oxide) was taken on the top of a Dowex 50 resin bed (2 cm. dia. \times 110 cm. long) by batch-wise equilibration. Elution was started with a 0.3% solution of sodium tripolyphosphate (w/v), which was increased to 0.5% after the first two

litres. The pH of the eluant was 3.6 for both solutions. Analyses of the starting mixture and the effluent fractions were done spectrophotometrically. The elution curve is given in Fig. 1.

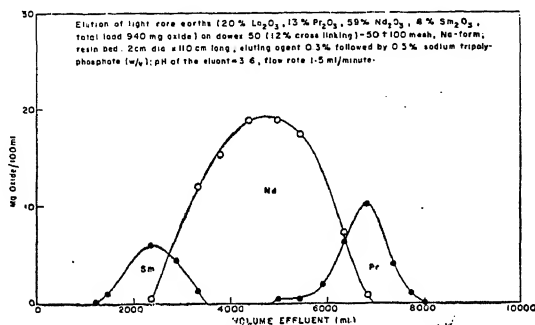


FIG. 1

The absence of lanthanum in the elution curve (Fig. 1) is due to the fact that lanthanum is retained on the exchanger.

Details of this investigation will be published shortly.

National Chemical Lab., P. R. SUBBARAMAN.
Poona-8, K. S. RAJAN.
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SOME PHARMACOLOGICAL ACTIONS OF EVOLVINE HYDROCHLORIDE

In a previous communication,¹ it was reported that a basic liquid substance, isolated from *Evolvulus alsinoides* (Vishnugrandhi), exhibited lobeline-like action on cardiovascular and respiratory systems. Attempts at further purification, resulted in the isolation of a crystalline hydrochloride, named provisionally Evolvine hydrochloride ($\text{C}_{12}\text{H}_{17}\text{NO}_2 \cdot \text{HCl}$, M.P. 216°). With the amount of this substance made available, a few pharmacological actions were studied to elicit if this exhibited properties similar to the liquid material.

Materials and Methods.—Cats weighing between 2-4 kg. were used. After preliminary æther, anaesthesia was maintained with chloralose administered intravenously (80 mg./kg. as a 1%

solution). In some experiments dogs weighing between 5-10 kg. were used, anaesthetised with chloralose, in the same dose range, without preliminary æther.

Blood pressure was recorded from a carotid artery. Trachea was cannulated and respirations recorded by a Mary's tambour. A femoral vein was cannulated for injection of drugs. Spleen volume was recorded by enclosing the spleen in an oncometer, and connected to a sensitive tambour. The peripheral pressure was recorded from a femoral artery by Rawolf's method. Studies on isolated tissues were carried out using one horn of rat's uterus, and a small piece of rat's ileum about 2 cm. in length, suspended in oxygenated Dale and Tyrode solutions respectively, in a 50 ml. bath, maintained at a constant temperature (37°C .)

Dosage Schedule.—The drug was used in doses of 1 mg. and 2 mg./1 kg. body weight, for systemic administration. A dose of 1 mg. was added to the bath, for effects on isolated tissues, and the same dose was used for injection into the peripheral circulation. During preliminary tests, the substance exhibited sympathomimetic activity. Hence Adrenaline in doses of 0.1 ml. to 0.2 ml. of a 1:10,000 solution was used wherever necessary for comparison. Sufficient time (from 15-30 minutes) was allowed between doses, for the responses to recover to preinjection levels.

Results.—The effects on blood pressure, spleen volume, and respiration, of a 1 mg./kg. dose of Evolvine hydrochloride compared to 0.1 ml. of 1:10,000, Adrenaline are seen in Fig. 1. They closely resemble each other, except that the blood pressure remained elevated for a longer duration, compared to adrenaline. The effects on respiration by Evolvine were neither sustained nor lobeline like.

The intensity of response was not proportionate when the dose was raised to 2 mg./kg. (Fig. 2). Neither repetition of the same dose nor an increase in the dose range was found to improve the responses.

An increase in peripheral pressure was noticed, when the drug was injected locally, as well as into general circulation (in suitable doses) indicating peripheral vaso constriction (Fig. 3).

Intracarotid injection of the drug (1 mg.) produced a rise in blood pressure, which was sustained for an appreciable time. Effects on respiration were not significant (Fig. 4).

Isolated Tissues.—Uterus: Significant relaxation, and later on a decrease in frequency, and height of contractions were noticed, with 1 mg. of Evolvine added to the bath (Fig 5).

Next, contraction was induced by adding 1 unit of oxytocin to the bath. When it was at its maximum the bath was quickly changed and 1 mg. of the drug was added. Again relaxation was evident (Fig 6).

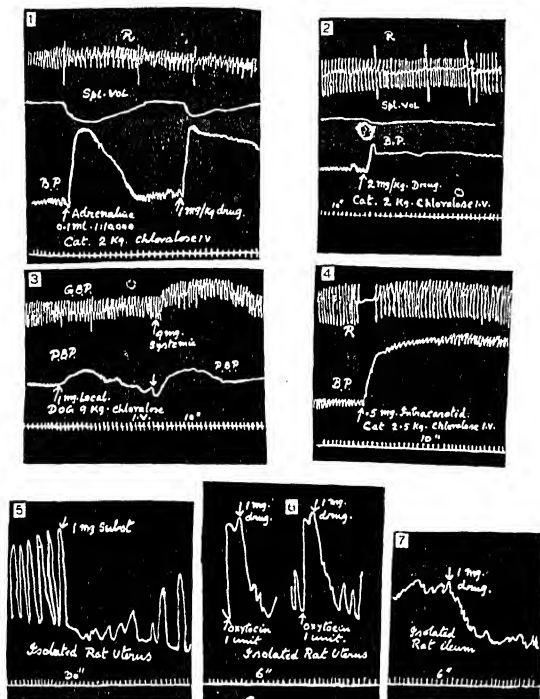


FIG. 1. Cat 2 kg. Chloralose Anesthesia. Record from above downwards: Respiration, spleen volume, blood pressure and time marking 10".

At first arrow: Adrenaline 0.1 ml. of 1:10,000 I.V. At second arrow: 1 mg./kg. of Evolvine hydrochloride I.V. Note the similarity in effects. B.P. after the drug tends to remain elevated.

FIG. 2. At arrow 2 mg./kg. of Evolvine administered I.V. Note: No increase in response noticed.

FIG. 3. Dog 9 kg. Chloralose. Upper tracing: Systemic B.P. Lower: Peripheral blood pressure. Arrow at lower tracing: 1 mg. of the drug locally: A rise in peripheral pressure was seen. Arrow at the upper tracing: 9 mg./kg. I.V.: The rise in peripheral pressure was prominent.

FIG. 4. At arrow 0.5 mg. of Evolvine intracarotid. Note: The prompt sustained rise in B.P. No significant effect on respiration.

FIG. 5. Isolated Rat Uterus: Relaxation on addition of 1 mg. of the drug at arrow to the bath.

FIG. 6. Isolated Rat Uterus: At lower arrow: 1 unit of oxytocin. At upper arrows: 1 mg. of drug after changing the bath. Note the relaxation.

FIG. 7. Isolated Rat's Ileum: At arrow 1 mg. of drug added to bath. Note: Significant relaxation. Movements not completely abolished.

Ileum.—Decrease in tone, without complete abolition of fine movements, was noticed (Fig. 7).

The data so far obtained indicate that Evolvine hydrochloride has a sympathomimetic

action. The effects on blood pressure are more sustained compared to Adrenaline, though the dose of Evolvine required to produce an equal effect is high: Tachyphylaxis is a feature of the drug. Peripheral and splanchnic vaso constriction seem to contribute a large measure, in bringing about a rise in blood pressure. The elevation in blood pressure, seen following intracarotid injection, indicates a central action in addition, probably mediated through the carotid sinus mechanisms. However, all the three factors seem to contribute to the effects noticed. Evolvine has not exhibited significant effects on respiration, compared to the stimulant action noticed with the liquid material previously. This action might have been due to some fraction contained in the liquid material and absent in the purified substance.

Evolvine hydrochloride seems to mimic adrenaline in some respects and Ephedrine in others. Further elucidation is required to come to any conclusion. This will be taken up when more of the drug is available.

Summary.—Evolving hydrochloride possesses sympathomimetic properties. For its inclusion, as a useful member of sympathomimetic family of drugs, further investigation is necessary.

I am grateful to Mr. M. V. Rama Rao, and Mr. T. S. Vaidyanathan of the Pharmaceutics Department, Madras Medical College, for making the substance available.

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Pharmacology Laboratory,
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TETRACYCLINES

Part II. Synthesis of 2, 8-Dimethoxy-5, 5 α , 6, 11, 11 α , 12-Hexahydronaphthacene-6, 12-Dione

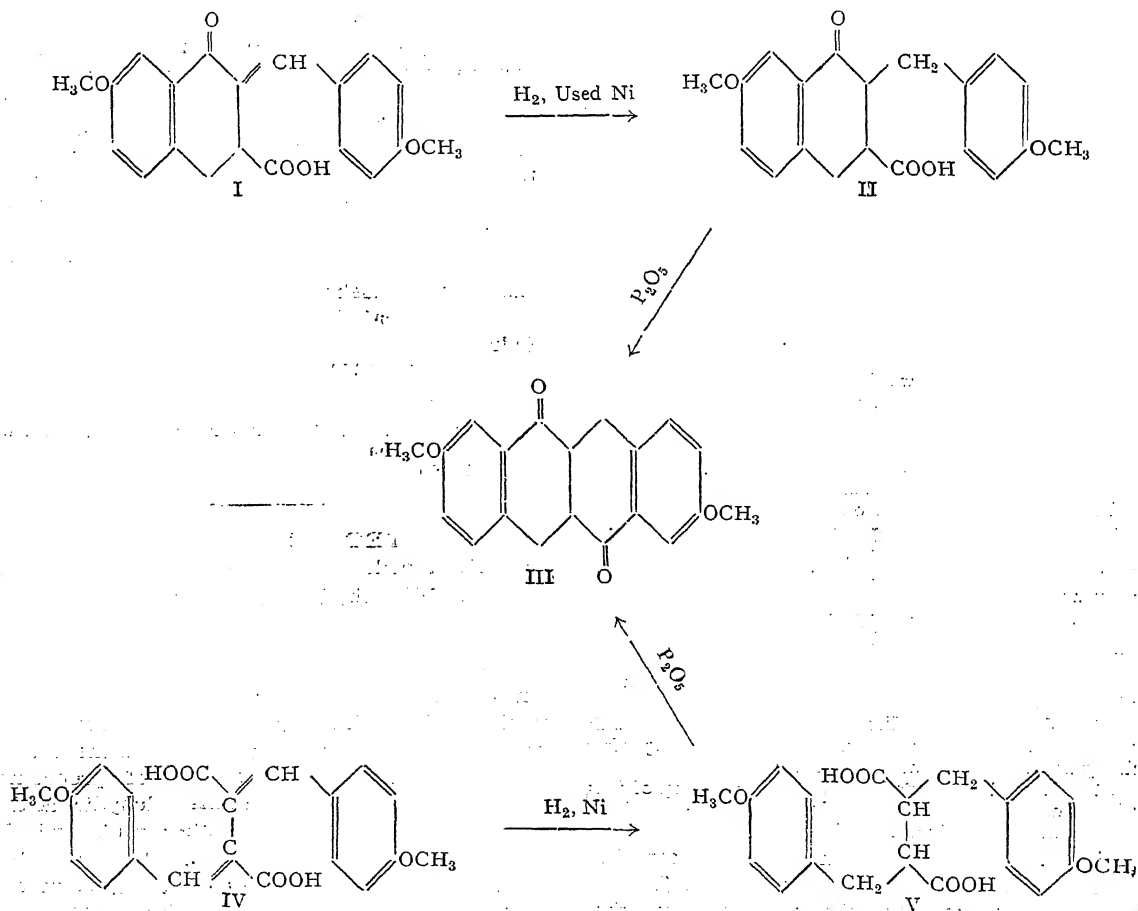
In a recent communication,¹ the synthesis of 7, 10-dimethoxy-5, 6, 11, 12-tetrahydronaphthacene-6, 12-dione was reported. The low yield of the hydronaphthacene in the last step, viz., cyclisation of the *o*-carboxy benzylidene tetralone, as well as the difficulty of preparing appropriately substituted phthalaldehydic acids, prompted us to search for other routes which would lead to the desired compounds in better overall yield from more easily accessible materials. The present paper outlines one such route.

7-Methoxy-3-carboxytetralone² was condensed with anisaldehyde in the presence of alkali to give 7-methoxy-3-carboxy-2-anisylidenetetralone (I); crystallised from dilute acetic acid, m.p. 180-81°. (Found: C, 71.1; H, 5.2% $C_{20}H_{18}O_5$ requires C, 71.0; H, 5.3%.) Attempts to cyclise (I) to the corresponding hexahydronaphthacene using polyphosphoric acid or phosphorus pentoxide in boiling benzene gave very small quantities of a highly coloured material which could not be isolated in a crystalline form. Reduction of (I) in alkaline solution by hydrogen in the presence of used Raney nickel gave 7-methoxy-3-carboxy-2-anisyl-tetralone (II); crystallised from ethyl acetate-petroleum ether (40-60°), m.p. 163-65°. (Found: C, 70.8; H, 5.6%; $C_{20}H_{20}O_5$ requires C, 70.5; H, 5.9%.)

Cyclisation of (II) by phosphorus pentoxide in boiling benzene gave 2, 8-dimethoxy-5, 5 α , 6, 11, 11 α , 12-hexahydronaphthacene-6, 12-dione (III) in good yield; crystallised from benzene, m.p. 238-40°. Found: C, 74.3;

H, 6.0%; $C_{20}H_{18}O_4$ requires C, 74.5; H, 5.6%; bis-2, 4-dinitrophenylhydrazone crystallised from nitrobenzene, m.p. 308° (dec.). (Found: C, 56.4; H, 3.9; N, 16.4%; $C_{32}H_{26}N_8O_{10}$ requires C, 56.4; H, 3.7, N, 16.4%.)

Weizmann³ described the synthesis of 5, 5 α , 6, 11, 11 α , 12-hexahydronaphthacene-6, 12-dione by the cyclisation of dibenzyl succinic acid. It was found possible to synthesise (III) by the same route and confirm its structure. Dianisylidene succinic acid⁴ (IV) was reduced in alkaline solution by hydrogen in the presence of Raney nickel to give dianisyl succinic acid (V), crystallised from acetic acid, m.p. 200-201°. (Found: C, 67.2; H, 6.2%; $C_{20}H_{22}O_6$ requires C, 67.0; H, 6.1%.) The dicarboxylic acid (V) was cyclised by phosphorus pentoxide in boiling benzene to give a dione, and that it is (III) was confirmed by the melting point and mixed melting point determinations. The yield of (III) by the latter method was, however, very poor.



Further work is in progress employing substituted tetralone carboxylic acids and aromatic aldehydes.

Chemistry Department, S. SESHADRI.
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SILICON TETRACHLORIDE, A NEW CONDENSING AGENT FOR PECHMANN REACTION

OUT of several methods for synthesizing coumarins,¹ the Pechmann reaction,² consisting of condensation of a phenol with a β -ketonic ester, is considered to be the most convenient. In this reaction, the choice of a proper condensing agent plays a very important part. Sulphuric acid, phosphorous pentoxide, phosphorous oxychloride, anhydrous aluminium chloride and zinc chloride have been employed extensively to bring about the condensation.

In a search for a new condensing agent, it has been found that silicon tetrachloride serves as a good condensing agent for the condensation of the more reactive phenols with β -ketonic ester. Resorcinol and phloroglucinol condensed with ethyl acetoacetate in presence of silicon tetrachloride to give the corresponding coumarin derivatives. But, it failed to bring about the condensation in case of the less reactive phenols, such as phenol and methyl- β -resorcyate. The experimental procedure is as follows:

Silicon tetrachloride (25 ml.) was added to a solution of resorcinol (5.5 g.) in ethyl acetoacetate (6.5 g.) with constant shaking. The reaction mixture was refluxed on water-bath for 4 hours with a calcium chloride guard tube. It was then poured into ice and water. The product with silica was collected on the filter and washed several times with water. The crude product was dissolved in a minimum quantity of alcohol and filtered to remove silica. It was finally crystallized from aqueous alcohol; yield 2.5 g., m.p. and mixed m.p. with an authentic sample of 7-hydroxy-4-methylcoumarin³ was 185° C.

I am thankful to Professor Suresh M. Sethna for suggesting the problem and also for guidance and help.

Chemistry Department, K. N. TRIVEDI,
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SOME OBSERVATIONS ON A RICE DISEASE

IN 1955 complaints of an unknown disease of rice were received from some cultivators of Telengana. The trouble was found to be more serious in poorly drained soils and where high doses of ammonium sulphate were applied. The disease has been observed to occur in patches and usually appeared 4 to 6 weeks after transplanting (Fig. 1). The tips of leaves of the



FIG. 1. Rice field affected by sulphide injury. affected crop dried up and assumed a brownish colour which in early stages resembled the symptoms of attack by *Curvularia lunata*. The affected leaves dried up prematurely and sometimes the entire plant died. It was found to be more serious during Rabi season (December-April), when the water-supply was not adequate, specially in areas where rice cultivation was done under lift irrigation.

The soil in the affected fields appeared dark and formed almost a crust on the surface. The roots of the affected plants appeared shining black instead of the normal whitish-brown colour and emitted sulphide odour. When they were washed in clean or running water and exposed to the atmosphere, the normal colour of the roots reappeared within 20 to 30 minutes. When the affected roots were placed in dilute hydrochloric acid, hydrogen sulphide was evolved. The black coating on the roots was

probably ferrous sulphide, which inhibited the absorption of food materials, causing the death of the plant.

The following methods have been found helpful in checking the harmful effects of sulphide injury:

(1) Flooding the fields and thoroughly stirring the soil either by hand or by a weeder, depending upon the cultural practices. Draining the fields until slight surface cracks appear and then letting in water. Repeating this alternate wetting and drying once or twice till the crop recovers. (2) Opening shallow drains around the fields to increase drainage. (3) Discouraging use of fertilizers containing sulphates in poorly drained soils. (4) As far as possible, not allowing drained water to pass through other fields.

Help of T. Seshagiri Rao is gratefully acknowledged.

Directorate of Plant Protection, D. BAP REDDY,
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July 15, 1958.

[Hydrogen sulphide in waterlogged soils is formed mainly by reduction of sulphate, for which the cellulose—butyric acid fermentation provides the hydrogen source. Use of ammonium nitrate mixed with powdered lime in the field was found to be effective in controlling the sulphide injuries. The atomic hydrogen, formed by butyric acid fermentation, is used to reduce nitrate, and consequently the sulphate reduction is prevented. R. Vamos in Nature, Dec. 13, 1958, p. 1688.—Ed.]

OCCURRENCE OF MONAZITE IN CHARNOKITES

ALMOST immediately after monazite was noticed in the beach sands of Visakhapatnam coast by Mahadevan and Sriramadas,¹ its source was ascribed to the neighbouring pegmatites.² In a recent issue of this journal, Murty³ has reported the occurrence of monazite in the charnockites of the Visakhapatnam area.

The recognition of monazite not only in the pegmatites but in the charnockites and leptynites of the Visakhapatnam area brings this into line with similar occurrences in Travancore. Tipper⁴ in 1914 believed that the gneissic rocks of South Travancore provided the source for this mineral. In 1921, Chacko⁵ stated that the pegmatites and the leptynitic gneisses of this region were the primary sources of the monazite sands.

In 1953, the present writer⁶ stated that the monazite beach sands of Travancore were in part derived from the charnockites. It was

Paulose,⁷ however, who recently provided accurate information on the rocks of South Travancore which contain monazite. By microscopic examination and heavy mineral analysis he showed that the leptynites and acid charnockites were monazite-bearing, whereas intermediate and basic charnockites were devoid of this mineral. In the Visakhapatnam area also the basic charnockites do not contain monazite, whereas acid and intermediate charnockites are monazite-bearing, the former being richer in the mineral than the latter.

I have examined many thin sections of Travancore charnockites and leptynites which contain this mineral, and have been struck by the smooth rounded or oval outlines of the monazite grains occurring in them. In fact, a concentrate of this mineral obtained from these rocks is practically indistinguishable from the rounded grains found at present in the beach sands. The characteristically anhedral and rounded or oval nature of this mineral has been noticed not only in South Travancore,⁸ but now in the Visakhapatnam area⁹ also.

Monazites occurring in the pegmatites near Bangalore have well-developed crystal faces. I have not examined the monazite-bearing pegmatites of South Travancore or the Visakhapatnam areas, but it is to be expected that the mineral would be somewhat euhedral.

Leptynites have generally been considered as metamorphosed sediments, and the rounded or oval nature of small monazite grains in them is therefore, not difficult to explain. The occurrence of such rounded grains in charnockites, however, is intriguing. It may well be that the monazite-bearing 'acid' charnockites were also originally sediments which contained detrital grains of this mineral.

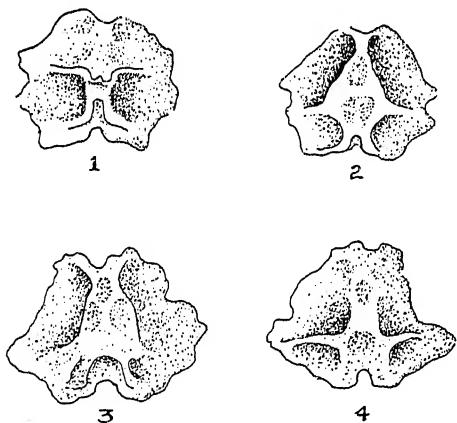
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OCCURRENCE OF OPHIUROID OSSICLES IN THE MIOCENE OF KATHIAWAR, WESTERN INDIA

THE object of this paper is to place on record the discovery of abundant ophiuroid ossicles (arm bones) in the Miocene (Burdigalian) beds of Kathiawar, Western India. Although the ophiuroids are plentiful in the present-day seas, their fossil records have been scanty. This is due chiefly to the fragile structure of the organisms themselves. Complete specimens are rarely found as fossils, though individual specimens of the arm bones are fairly common in some Tertiary sediments. This paper reports first known occurrence of Tertiary ophiurans from India.

The material on which the present paper is based was collected by Dr. Krishna Mohan (now working at the State Museum, University of Nebraska), during the field seasons 1952, 1953, 1954, and subsequently handed over to the author for a detailed study of the microfossil contents. The specimens of ophiuroid ossicles were obtained from sample 'H' (*vide* Mohan and Chatterji³) from the 'Orbiculina' limestone exposed 1½ miles N. 34° E. of Bhogat village (21° 59' N. : 69° 14' E.). A few of these arm bones are illustrated here (Figs. 1-4).



FIGS. 1-4. Arm bones of Miocene ophiuroids from Kathiawar. All figures, $\times 35$. Figs. 1 and 3, outer face; Figs. 2 and 4, inner face.

A majority of these specimens were recovered from washings retained on the 40-mesh sieves.

The stratigraphical significance of the ophiuran arm bones was first stressed by Howe,² in his paper 'Neglected Gulf Coast Tertiary Microfossils'. The ecological significance of recent ophiuroids was discussed by Lyman,⁴ who noted that the majority of the species lived in a zone lying between the low-tide mark and 180 feet.

Of the various genera reported by him, sixteen do not go lower than 30 fathoms and are usually common in warm waters.

The presence of ophiuran arm bones in the Miocene of Kathiawar, therefore, appears to be of some ecological significance. Bhatia and Mohan¹ studied in detail the palæoecology of the Kathiawar Miocene, and, on the evidence furnished by the foraminiferal fauna, concluded that the 'Orbiculina' beds, together with the Visawara limestone, were deposited in a shallow infra-neritic sea, at depths between 20 and 100 fathoms. These conclusions are further corroborated by the presence in these beds of large number of ophiuran arm bones.

In the absence of any schematic classification of ophiuran arm bones and also due to the lack of preservation of mouth parts, no specific identification is possible at present. However, the present study indicates that these arm bones belong to Lyman's family Ophiuridae. Detailed work on these is in progress, and the results will be published shortly.

The author wishes to thank Dr. Krishna Mohan for the loan of the material and also for permitting him to publish this paper.

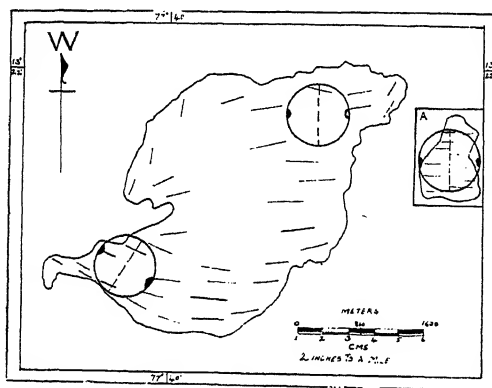
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A NOTE ON THE JOINT PATTERN IN NANDI GRANITES

It has been admirably demonstrated by Cloos² (1937) and Balk³ (1948) that joints in granites are very suggestive of their mode of emplacement. It may be stated that this line of approach is still in its infant stage in Mysore, despite the availability of quite a large number of granite bodies. The only contribution in this direction is by Srinivasa Rao⁴ (1956) on Chamundi granites. Similar lines of investigations have been undertaken by the writer on the Nandi granites and an attempt is made in this note to present the results of the preliminary study.

The granite body under study crops out as an elongated lenticular mass, situated in Kolar District, Mysore State. The rocks are generally a series of grey coarse to fine grained gneissic granites, ranging in composition from granites to granodiorites. In the field the out-crop grades into a series of gneissic rocks, containing a number of autoliths. Further outwards, in the country rocks, basic xenoliths of various sizes are seen arranged in an en-echelon manner. Just along the borders of the out-crop there are numerous 'schlieren' patches forming quite a conspicuous feature. In the present study the orientation of the joints in the field has been obtained with reference to the foliation directions, seen in the rocks. This helps to fix up the nature of joints. Without this they are not absolute and no definite orientation of the joints could be ascertained.



Map 1

Generalized Foliation Direction in Nandi Granites.

(Inset A) Isolated out-crop to the east of the main granitic body. (Inscribed circles indicate the orientation of "Q" joints.)

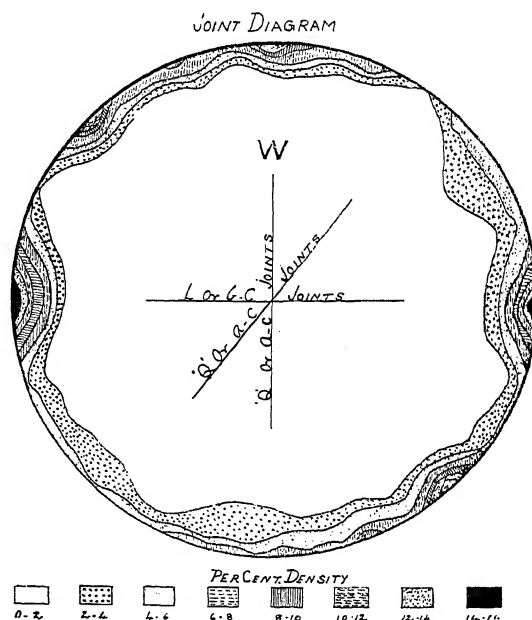
About hundred compass readings of joints obtained all over the exposed portions of the out-crop were projected on to a 2" to 1 mile map. Further the poles of the joint planes were plotted on Schmidt equal-area projection and a contour diagram was prepared (Billings).¹

An examination of the map and joint diagram shows that there are at least two prominent sets of joints.

- (1) Parallel to foliation direction (Longitudinal joints).
- (2) Perpendicular to foliation direction (Cross-joints).

In conventional terms the former is called the 'L' or b-c joints and the latter is called the 'Q' or a-c joints. Further it is interesting to

note that the 'Q' joints show two maxima on the point diagram. i.e., 16 to 14% density, and 14 to 12% density, separated by an angle of 20 to 30°. Besides the above types of joints, there are also a few random diagonal joints or 'D' joints. The general trends of the foliation direction, shown in map, are also in agreement with the two maxima of the 'Q' joints. Further it is seen from the diagram that the most prominent jointing direction is North-South varying to NNE. Next to this is the East-West jointing direction, with a few irregularly arranged joints.



Contour diagram of 100 joints plotted on Schmidt equal-area projection

At this stage of investigation, it is very difficult to ascertain the exact mode of emplacement of these granite bodies. But a suggestion could be made, as far as the present study discloses, that foliations in these granites are the result of movements in late fluid stage and joints are the products of solidification and continuous movements at late solid stage resulting in ruptures and fractures. Further work in this respect is in progress.

The writer wishes to express sincere thanks to Prof. M. R. Srinivasa Rao for suggestions and guidance throughout the preparation of this note. Grateful acknowledgement is made to

Dr. C. Gundu Rao for critical reading of the manuscript.

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CATION EXCHANGE CAPACITY OF PLANT ROOTS

ALTHOUGH Devaux¹ reported the existence of cation exchange properties of roots as early as 1916, the importance of this phenomenon has not been recognised till recently. Arnon *et al.*² showed that plants actually lost metal cations to culture solutions at pH 3. Ramamoorthy and Desai³ reported that manganese is exchanged for iron by the tobacco leaf during the recovery of a manganese induced iron deficiency and chlorosis. It remained, however, for Williams and Coleman⁴ and Drake *et al.*⁵ to show experimentally that plants have cation exchange capacities of considerable magnitude. This capacity has also been shown to be important in determining the compatibility of plants under mixed cropping⁶ and the ratio of the uptake of monovalent to divalent cations by plants.

Schuffelen and Middelburg have proposed a rapid method for the determination of cation exchange capacity of plant roots suitable for routine work in which mature roots after being dried and ground were leached with dilute acid, saturated with calcium by leaching with calcium acetate solution and the cation exchange capacity (C.E.C.) is calculated by estimating the calcium held after removing the excess of calcium acetate solution and displacing the calcium by finally leaching with dilute acid. Some of the values obtained by using a slight modification of this method are given in Table I. In this, ordinary funnels fitted with Whatman filter-paper No. 40 were used and calcium was estimated by versenate titration after neutralising the acid with sodium hydroxide solution using a litmus paper. The volume of the acid used for the final leaching was 100 ml. Plants which were nearly three and a half months old were up-rooted carefully from the Institute Farm late in February, 1958, the entangled soil

was removed by washing them in running water in the irrigation canal and finally in distilled water. The roots were then excised, dried in the oven at 60° C. and powdered, 0.5 to 1.0 g. of the composite sample in triplicate were taken for each analysis.

TABLE I

Plant	C.E.C. in m.e./100 g. of dry root
Wheat	9.7 ± 0.5
Barley	11.9 ± 0.2
Linseed	22.5 ± 0.1
Halbrum	27.6 ± 1.0
Peas	33.4 ± 0.4
Gram	35.3 ± 0.3

It is seen from this table that the dicotyledons have higher values than the monocots as reported in literature (1) and that the values for wheat and barley agree with the values of 9.0 and 12.3 reported by Drake, Vengris and Colby⁷ using an entirely different method consisting of electro-dialysis and titration to an extent better than those of Schuffelen and Middelburg who obtained values of 13.5 and 17.5 respectively.

My thanks are due to Dr. B. Ramamoorthy, Physical Chemist of this Institute, for his guidance during the course of this work.

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THE OCCURRENCE AND FUNCTION OF THE PROVISIONAL EMBRYONIC CUTICLE OF *TENEBRIO MOLITOR* (COLEOPTERA)

In the eggs of *Tenebrio molitor* reared at 30° C. and 90% R.H. the provisional embryonic cuticle started forming about 96 hours after the laying of the eggs. This cuticle sloughed off on the sixth day and a new cuticle started forming in its place. The epidermis showed intense activity during the time of secretion and moulting of the cuticle. On the fifth and sixth day a large number of multicellular, tubular dermal glands made their appearance in the region of the epidermis. These glands are provisionally regarded as moulting glands because of their appearance only at the time of moulting of the provisional cuticle.

One of the chief functions of the cuticle is to act as an exoskeleton to resist the pull of attached skeletal muscles. So, careful observation was made to find any relationship existing between the embryonic cuticles and developing skeletal muscles. At the time of deposition of the provisional embryonic cuticle (96 hours after the deposition of the eggs) the muscles were only being differentiated from a group of myoblast cells (Fig. 1). The myoblast were

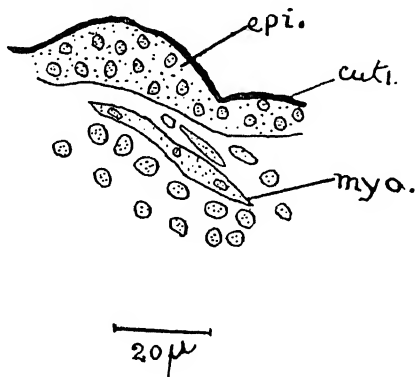


FIG. 1. *epi.*, epidermis; *myo.*, myoblast; *cut1*, provisional embryonic cuticle.

first observed with certainty 24 hours earlier. The muscles were contiguous with the epidermis during embryogenesis. These skeletal muscles, at such an early stage of their development, were not in a position to gain attachment with the provisional embryonic cuticle. So the skeletal muscles gained attachment with the second embryonic cuticle on the seventh day, i.e., just before the emergence. The attachment of the muscles to the second embryonic cuticle was effected through tonofibrils, which are ectodermal in origin (Henneguy, 1906).

Attachment is also indicated by the appearance of striations in the muscle fibres. In *Tenebrio molitor* nuclei disappeared completely from that part of epidermis where tonofibrillæ were formed (Fig. 2).

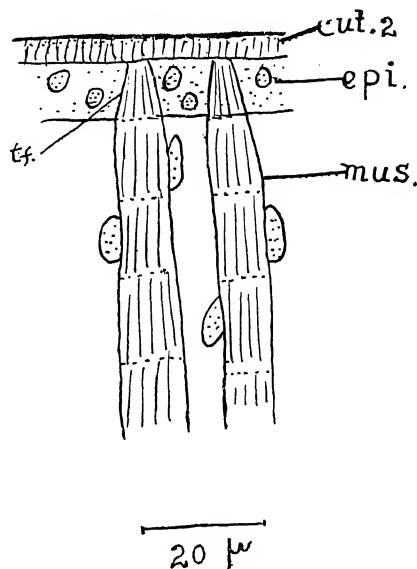


FIG. 2. *epi.*, epidermis; *cut2*, second embryonic cuticle; *mus.*, striated muscle fibres, *tf*, tonofibrillæ.

It is clear, therefore, that a deposition of the provisional embryonic cuticle does not synchronise with the developing muscle fibres. So to do away with this anomalous position the provisional embryonic cuticle is shed so that the skeletal muscle may gain attachment with the second embryonic cuticle.

I wish to thank Dr. B. M. Jones of the Edinburgh University, for his help in this work.
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OVIPOSITIONAL HABITS OF *DACUS* SP. (TRYPETIDAE: DIPTERA)

IN Mysore State *Coccinia indica* N. & A. (Cucurbitaceæ), apart from being cultivated as a vegetable, is also found growing wild, in which state it is found very commonly attacked by *Neolasioptera cephalandrea* Mani causing stem galls.

Apart from the stem gall midge, *C. indica* is also subject to infestation by three species of *Dacinae* in Mysore (Puttarudriah and Usman,

1954). In the course of investigation it has been observed that *Dacus* sp. apart from infecting tender fruits of *C. indica* may also attack the stem galls caused by *N. cephalandræ* and successfully completes a life-cycle therein. Fig. 1 shows two dissected stem galls containing



FIG. 1. Photograph showing *Dacus* sp. Larvæ and pupæ in *Coccinia* stem galls.

larvæ and pupæ of the fruit-fly. The infested stem galls lose their turgidity and become pulpy. In the course of the larval development of the fruit-fly, the maggots of the midge *N. cephalandræ* are completely destroyed.

Dacineæ are known also independently to cause the formation of galls on cucurbits. Back and Pemberton (1917) have recorded instances of *Ceratitis capitata* Wied. ovipositing and causing galls to develop on the vines of squash and cucumber in Hawaii. Mani (1953) has reported the occurrence of galls on the stems of *Cucumis* sp. caused by *Dacus cucurbitæ* Coq. In a personal communication, he observes, "a plant gall also is a part of the plant that can and does serve as a good and suitable food material" and added that he had once observed in a locality at Agra where every gall on a *Coccinia* plant had been oviposited by *Dacus* sp. This habit of *Dacineæ* is very interesting and further studies are in progress with reference to the seasonal incidence, survival ratio and parasite complex of *Dacus* sp. infesting *Coccinia* stem galls.

I am grateful to Dr. M. Puttarudriah, Government Entomologist, for his interest and encouragement. My sincere thanks are due to Dr. M. S. Mani, Deputy Director, Zoological Survey of India, for information on stem galls caused by *Dacineæ*.

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AN INSTANCE OF HERMAPHRODITISM IN THE INDIAN MACKEREL *RASTRELLIGER CANAGURTA* (CUVIER)*

WHILE instances of hermaphroditism are known to occur in the European mackerel (*Scomber scombrus* L.),^{1,2} no such cases are on record for the Indian mackerel, *Rastrelliger canagurta*. It is interesting to report, therefore, the occurrence of a single hermaphrodite specimen of *R. canagurta* in a sample taken from the fish market at Karwar and reported to have been caught at Majali, seven miles north of Karwar on 25th March 1958. Both in external appearance and in the other features of the internal anatomy, no abnormalities were noticed in the specimen. It measured 21.4 cm. in total length.

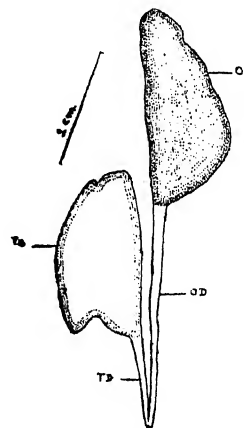


FIG. 1. Showing the relative position, shape and size of the gonads. OV: Ovary; OD: Duct of the ovary; TS: Testis; TD: Duct of the testis.

The left gonad, situated slightly anterior to the right one, was yellowish red in colour and showed the characters of an ovary in stage III of maturity. While the ovary, attached to the wall of the body cavity by a thin mesovarium

* Published with the kind permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

was 1.7 cm. in length and 0.7 cm. in breadth, the oviduct commencing from the posterior end of the ovary measured 1.9 cm. in length. Microscopical examination of the ovary revealed the presence of yellowish yolky eggs ranging in size from 0.15 mm. to 0.31 mm. mixed with a large number of transparent immature eggs. The absence of larger eggs and the compactness of the ovary indicated that this fish was probably attaining maturity for the first time. The right gonad, connected to the dorsal wall of the body cavity by a thin mesorchium, was milk-white in colour in clear contrast to the left gonad and measured 1.4 cm. in length and 0.7 cm. in width with the duct running 0.8 cm. Microscopic examination of this gonad revealed the absence of eggs and the presence of cells similar to that of a normal testis. The genital ducts, lying parallel to each other very closely, appear to open outside through a common aperture. The relative position, shape and size of the two gonads and their ducts are shown in Fig. 1.

The hermaphrodite mackerel has been carefully preserved for further examination.

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A NOTE ON THE LEAF WEBBER *STRIGLINA SCITARIA*, Wlk. ON *SESBANIA ACULEATA* (DAINCHA) IN MADRAS STATE

Sesbania aculeata is one of the important and popular green manure crops grown extensively in the Madras State. It is often subject to the attack of a number of Lepidopterous pests of which *Striglina scitaria*, Wlk. belonging to the family Thyrididae was recorded as a pest in 1892 (Hampson). The author noticed it as a serious pest for the first time on this green manure crop at Coimbatore. The pest is seasonal in occurrence and the outbreaks are confined to the period July to November, although it remains active throughout the year in association with *Maruca testulalis*, Geyer. It has a wide distribution throughout India, Japan, Formosa, Ceylon, Burma, Andamans, Borneo, New Guinea, Australia and Fiji. Hampson (1892), Gater (1925) recorded the occurrence of this pest on *Erythrina* sp., *Bauhinia purpuria* and *Derris elliptica* in Malaya. It is also noted on *Cassia corymbosa* and *Notonia grandiflora* at Coimbatore.

The larvæ does maximum havoc to the leaflets by scraping the green matter. The young

larvæ twist the terminal portions of the leaflets into small cones and live inside. The full-grown caterpillar webs together a number of leaflets and lives inside the tunnel and pupates.

Eggs are laid in a row on the edges of the leaflets in groups of 2 or 4. A single moth is capable of laying 25 to 30 eggs. The eggs hatch out in 2 or 3 days. The larval period ranges from 12 to 14 days during which it moults four times. The larvæ turns yellowish before pupation. Pupation takes place inside a cocoon of webbed leaflets with a coating of flimsy whitish silk. Pupal period lasts 6 to 8 days. The longevity of male and female moths ranged from 4 to 5 days with an average of 4.4 days.

The total life-cycle is about 20 to 25 days (Fig. 1).

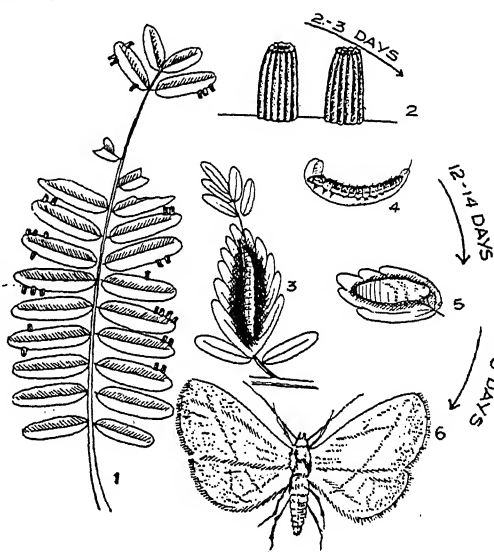


FIG. 1.

The results of trials with synthetic chemicals to control the pest clearly indicated that the pest could be completely checked by spraying of 0.1% of BHC or 0.1% of Dieldrin.

The author expresses his deep sense of gratitude to Dr. Ramdoss Menon, Systematic Entomologist, I.A.R.I., New Delhi, and Dr. T. S. Sadasivan, Director, Botany Laboratory, Madras University, for offering valuable suggestions. He is also indebted to Sri. P. S. Narayanaswamy, Government Entomologist, for affording all facilities during the course of the investigations. Entomology Division, S. VENUGOPAL.
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TEMPERATURE TOLERANCE OF THE LARVAE OF TEN SPECIES OF MARINE FISHES

A high rate of mortality among the larvæ was recorded when the yolk is absorbed and the digestive system of the pro-larvæ becomes modified to take in food in the post-larval stage. Such a problem confronted workers in the temperate regions also and the observations of Garstang (1900), Grawshay (1915), and Gross (1937), show that care has to be taken with regard to temperature, food, agitation of water and the attack of micro-organisms like ciliates and bacteria. Recent authors like Don Outram (1957) and Daniel (1952) also emphasized the importance of the temperature more than other factors. Attempts to rear the Marine fish larvæ in the laboratory both in this country and abroad have not met with uniform success. As far as the tropical species studied by the author are concerned, the larvæ appear to be affected mainly by temperature gradients. Therefore it was felt necessary to determine the temperature

The larvæ of each species of fish were maintained at different temperatures below 37° C., the highest surface temperatures of the sea recorded during the last three years at Madras. By keeping the larvæ at any particular temperature for a period of 12 hours and noticing the temperature level where the percentage of mortality was lowest the optimum temperature for the different stages of the larvæ of that particular species was ascertained. As the larvæ of different species of fish are hatched at different periods of the year when the temperatures of the air and of sea-water may vary, these data also were noted and included in Table 1. Since in a tropical place like Madras the temperatures of air and sea surface do not vary very widely during the different periods of the year, it is possible that the larvæ of the Madras species of fishes have a very narrow toleration range.

From Table I it will be evident that the early larvæ of *Cynoglossus lingua* and *Solea elongata* differ from their juveniles in their temperature relation. In the case of these two

TABLE I

Showing the temperature tolerance and optimum temperature for development of the larvæ of 10 tropical fishes

No.	Name of fishes	Total No. of fishes used	No. of experiments performed	Period	Length in mm.	Temp. of air in ° C.	Temp. of sea-water	Optimum temp.	Toleration range
1	<i>Polynemus indicus</i>								
	Pro-larvæ and post-larvæ	286	8	1956 Nov.	2.2- 9.2	31-35	30-32	29	28-31
2	<i>Sardinella longiceps</i>								
	Pro-larvæ and post-larvæ	381	12	1956 Jan.	2.1-11.3	32-35	31-23	29	28-31
3	<i>Dussumieria acuta</i>								
	Pro-larvæ and post-larvæ	128	3	1955 July	2.6-14.2	32-35	31-33	30	29-31
4	<i>Caranx mate</i>								
	Pro-larvæ and post-larvæ	99	4	1955 Oct.	1.5-10.3	30-33	29-30	28	27-30
5	<i>Megalaspis cordyla</i>								
	Pro-larvæ and post-larvæ	196	7	1957 Feb.	1.9-10.2	33-36	30-31	29	28-31
6	<i>Mugil cephalus</i>								
	Pro-larvæ and post-larvæ	281	9	1956 June	1.1- 7.2	34-36	32-34	30	29-32
7	<i>Cynoglossus lingua</i>								
	Pro-larvæ and post-larvæ	98	3	1956 May	2.2- 6.9			29	28-30
	Juveniles	66	3		7.1-15.3	34-36	31-33	22	20-23
8	<i>Solea elongata</i>								
	Pro-larvæ and post-larvæ	102	4	1956 Feb.	1.6-11.2			30	29-32
	Juveniles	79	3		11.8-13.8	33-36	32-33	22	21-23
9	<i>Saurida tumbil</i>								
	Pro-larvæ and post-larvæ	296	6	1956 Jan.	2.8-20.4	32-35	31-33	30	28-31
10	<i>Triacanthus brevirostris</i>								
	Pro-larvæ and post-larvæ	92	3	1957 April	3.2-18.8	32-37	31-33	29	28-30

optimum for the larvæ of the different species of fish. To do this, larvæ just hatched from the eggs of each species of fish were left in specially devised bowls which can be maintained at different temperatures.

bottom living fishes the development is gone through at a temperature far lower than that of the surface of the sea. But in the case of all the remaining eight species the larvæ appear to require a low temperature from the time of

hatching up to the end of the post-larval period. Hence these larvæ were reared in the cooling chambers only upto this period. Beyond the post-larval stage up to the time of their metamorphoses into juveniles they tolerated a much higher temperature and were reared in the laboratory temperature in open bowls.

I am thankful to Prof. C. P. Gnanamuthu and Dr. G. A. Stevan for their valuable suggestions.

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PINEAL ORGAN IN FISHES

THE present study on the pineal organ of catfishes shows that the organ is a well developed median glandular structure arising from the roof of the third ventricle with no sign of bilateral origin.

The observations are based on the studies of the following fishes.—*Mystus aor*, *Mystus seenghala*, *Mystus bleekeri*, *Mystus gulio*, *Mystus tengara*, *Wallago attu*, *Rita rita*, *Pseudotropius murius*, *P. garua*, *Bagarius bagarius*, *Eatropichthys vacha*, and *Clarius batrachius*.

From the roof of the third ventricle in-between the habenular ganglion and the posterior commissure comes out the pineal tract which is exceptionally long and has two accompanying blood vessels, all along its course. The pineal organ, the swollen terminal end of pineal tract, lies in a single median foramen termed the pineal foramen. This foramen is found in the frontal or in between the frontal and prefrontal region (Fig. 1).

The pineal organ and the pineal tract are glandular in nature and the former has no resemblance to any eye-like structure. In

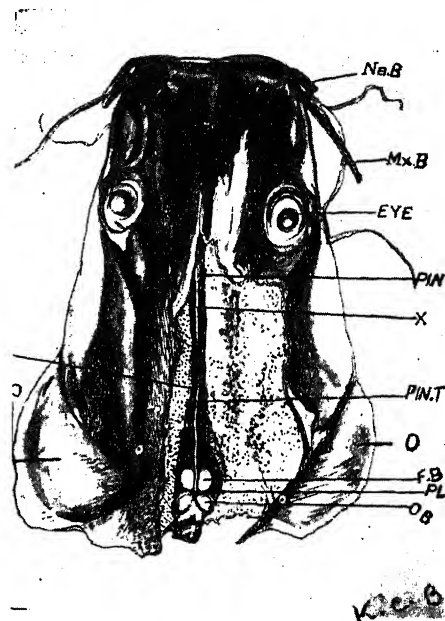


FIG. 1. Dissection showing the Pineal organ and tract in situ *Mystus aor* (Dorsal View), $\times \frac{1}{2}$.

F.B.—Fore brain;

Mx. B.—Maxillary barbel; Na B.—Nasal barbel;

O—Operculum;

OB—Optic bulb;

PIN.—Pineal organ;

Pin. T.—Pineal tract;

X—Pineal tract at this place gets thicker in diameter.

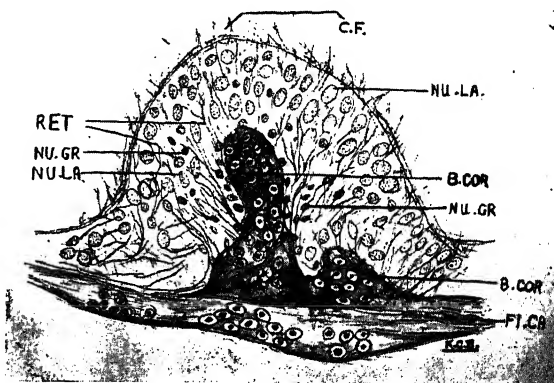


FIG. 2. Transverse section showing one of the finger-shaped processes of the Pineal organ of *Mystus aor*, $\times 400$.

B. COR.—Blood corpuscles; FI. CR.—fibrous covering;

NU. GR.—Small deeply staining nucleus;

NU. LA.—Large nucleus;

C.F.—Cell processes projecting into the lumen of the pineal organ;

RET—Reticulum.

adult specimens this organ does not show any sign of degeneration but grows with age.

Two types of cells are seen in the pineal system: one with the larger nuclei and the other with smaller nuclei. There is no cell-wall distinguishable in between. The cells and these nuclei are seen to be embedded in the network of the protoplasm. The nuclei are pigmented; the smaller one is much more granulated than the larger one. The nuclei can be differentiated into acidophilic and basophilic types (Fig. 2).

The lumen of the tract is continuous with the third ventricle at one end and the pineal organ at the other end. Some secretory patches are found in the lumen of the gland.

The histological structure of the pineal organ strongly indicates its glandular nature and in no case is the pineal organ a vestigial structure. Further work is in progress.

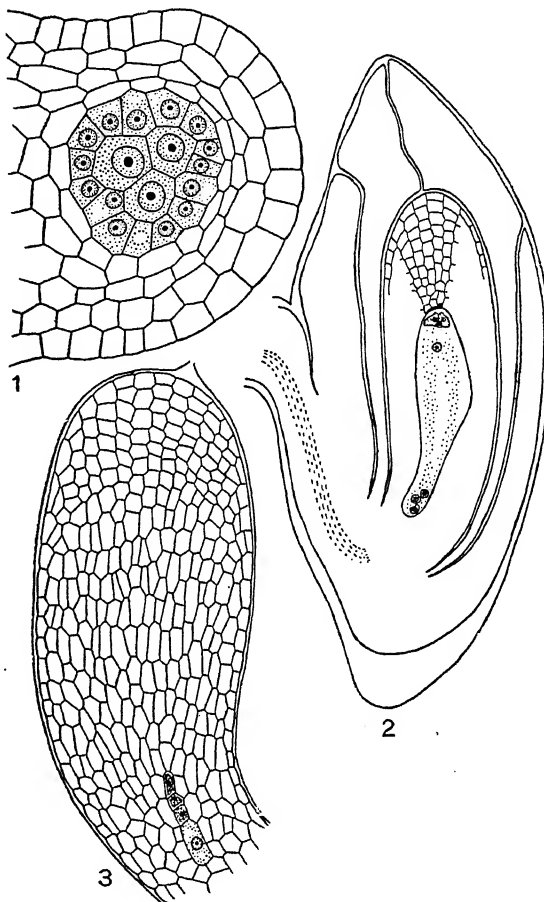
Univ. Dept. of Zoology, K. C. Bose.
Bihar University,
Ranchi,
August 6, 1958.

MICROSPOROGENESIS AND FEMALE GAMETOPHYTE IN *BOSWELIA SERRATA* ROXB.

THE important embryological work in the family Burseraceæ is that of Wieger (1935) who studied 16 species distributed in 5 genera. Recent embryological work in the family is on *Balsamodendron mukul* (Shukla, 1954) and on *Garuga pinnata* (Narayana, 1957).

The anther structure in *Boswellia serrata* shows an epidermis and four wall layers of which the innermost functions as the tapetum which is of the secretory type (Fig. 1). The tapetal cells are uninucleate in early stages and become binucleate by the time the pollen mother cells begin to undergo meiosis. The cells of the hypodermal wall layer develop into the fibrous endothecium in the mature anther. The middle layers become crushed during further development of the anther. A feature of interest is that the epidermal cells of the anther show papillate projections. Similar papillate projections from the cells of the anther epidermis have been reported in Meliaceæ (Garudamma, 1957 & Narayana, 1958). Meiosis in the pollen mother cells is normal. Cytokinesis takes place by furrowing. Pollen tetrads show tetrahedral arrangement. The pollen grains are two-celled at the time of shedding. The exine is smooth and the pollen grains are 3-colpate.

The ovary is 3-carpellary syncarpous, 3-locular with two ovules in each loculus. The ovules are crassinucellate, bitegmic and hemianatropous (Fig. 2). The integuments are free from one another and form the nucellus (Fig. 2).



FIGS. 1-3. *Boswellia serrata*. Fig. 1. T.S. of young anther lobe showing the epidermis, wall layers and the tapetum surrounding the sporogenous tissue, $\times 910$. Fig. 2. L.S. ovule showing the integuments, conducting strand and embryo-sac, $\times 230$. Fig. 3. L.S. ovule showing the megaspore tetrad with enlarging chalazal megaspore, parietal tissue and the nucellar cap. Integuments not shown, $\times 680$.

The inner integument which grows above the level of the outer, alone takes part in the formation of the micropyle. The conducting strand ends at the base of the chalaza (Fig. 2).

The primary archesporium in the ovule consists of a single hypodermal cell which can be distinguished by its possession of a larger nucleus and denser protoplasm. The primary archesporial cell cuts off a primary parietal cell before it becomes the megaspore mother

cell. A parietal tissue of several layers of cells is formed as a result of repeated periclinal and anticlinal divisions in the primary parietal cell (Fig. 3). The cells of the nucellar epidermis also undergo periclinal divisions resulting in the formation of a nucellar cap (Fig. 3). The megaspore mother cell undergoes meiosis and a linear tetrad of megaspores is formed (Fig. 3). The lowermost cell of this tetrad is functional (Fig. 3) and develops into the embryo-sac after three successive free nuclear divisions (Fig. 2), while the upper three become crushed during the development of the embryo-sac. Thus, the development of the embryo-sac in *Boswellia serrata* follows the normal type and it shows the usual organisation with an egg apparatus consisting of two synergids which show hooks and an egg, three antipodals and two polar nuclei which fuse in the middle. The embryo-sac enlarges during development and most of the parietal tissue becomes crushed.

The author expresses his grateful thanks to Prof. J. Venkateswarlu who suggested the problem and under whose guidance this work was completed at the Andhra University.

Department of Botany, L. L. NARAYANA.
Osmania University,
Hyderabad-Dn. 7,
August 21, 1958.

1. Garudamma, G. K., *J. Indian bot. Soc.*, 1957, **36**, 227.
2. Narayana, L. L., *Sci. and Cult.*, 1957, **23**, 248.
3. —, "Floral Anatomy and Embryology of *Cipadessa baccifera* Miq.," *J. Indian bot. Soc.*, 1958, **37**, 147-154.
4. Shukla, R. D., *Curr. Sci.*, 1954, **23**, 333.
5. Wieger, J., "Embryological studies in the families Buxaceæ, Meliaceæ, Simarubaceæ and Burseraceæ," *Diss. Lund*, 1935.

CHROMOSOMES OF FIVE INDIAN AND CEYLONESE GRASS SPECIES

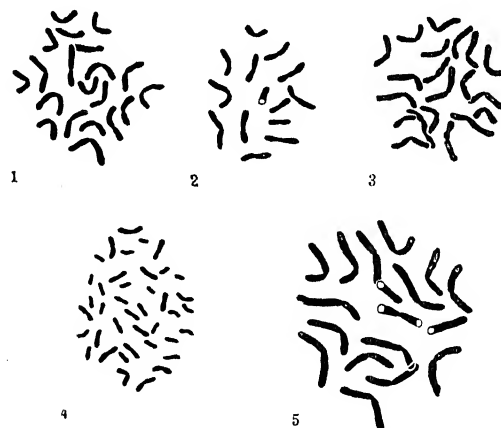
For the natural classification of Gramineæ the examination of chromosome features of various species is needed. For this purpose, the root tips of some Indian and Ceylonese grasses were fixed with Navashin solution by the writer during his sojourn in India and Ceylon. After his return to Japan, they were dehydrated and embedded in paraffin. Sections were cut at 15 micra and stained by Newton's gentian violet method.

Five species whose chromosomes are reported here are listed in Table I. The counts in two species of *Arundinella* are new, while there are previous reports for the chromosomes of the three other species.

TABLE I

Species	Localities	2n	Fig.
<i>Arundinella villosa</i> Arn. ex Nees	Dulva Kanda (Ceylon)	14	2
<i>A. blephariphylla</i> Trim. ex Hook. f.	Peradeniya (Ceylon)	20	1
<i>Garnotia scoparia</i> Thw.	Dulva Kanda; Dambulla Rock (Ceylon)	20	3
<i>Perotis patens</i> Gand.	Cuttack (India)	40	4
<i>Spinifex littorens</i> Merr.	Madras (India)	18	5

In *Arundinella*, two basic chromosome numbers occur; $b = 7$ and 10. Moriya and Kondo observed $n = 14$ in *A. hirta* Tanaka; Tateoka found $2n = 56$ in the same species. These numbers are suggestive of the basic number of 7, and the present observation on *A. villosa*, showing $2n = 14$ clearly indicates the presence of basic 7 which is rather unusual in Arundinellæ and related tribes. On the other hand, Ramanathar reported $2n = 20$ for *A. setosa* Trin. The same number is found in *A. blephariphylla* (Fig. 1



FIGS. 1-5. Somatic chromosomes, $\times 2,000$. Fig. 1. *Arundinella blephariphylla*. Fig. 2. *A. villosa*. Fig. 3. *Garnotia scoparia*. Fig. 4. *Perotis patens*. Fig. 5. *Spinifex littorens*.

These two species may be diploids representing the basic number of 10.

Tateoka⁶ pointed out a similarity of chromosome structure in *Arundinella* and *Garnotia*. *scoparia* has the basic number of 10, showing $2n = 20$ which accords with Ramanathar's observation. The chromosome morphology of *Arundinella* and *Garnotia* is very similar as shown in Figs. 1-3. These facts indicate a relationship between the two genera. For *Perotis* two different chromosome numbers were reported; $2n = 36$ (de Wet and Anderson) and $2n = 40$ (Moffett and Hurcombe²). J

present observation accords with the latter. *Spinifex littoreus* is a dioecious plant. Unfortunately the writer could not distinguish the sex of the individual used because it was not flowering.

National Institute of Genetics, T. TATEOKA.
Misima, Sizuoka Pref.,
Japan,
August 18, 1958.

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2. Moffett, A. A. and Hurcombe, R., *Heredity*, 1949, 3, 269.
3. Moriya, A. and Kondo, A., *Jap. Jour. Gen.*, 1950, 25, 126.
4. Ramanathan, K., *Curr. Sci.*, 1950, 19, 155.
5. Tateoka, T., *Cytologia*, 1954, 19, 317.
6. —, *Bot. Gaz.* (in press).

THE OCCURRENCE OF POLY-HUSKED SPIKELETS AND OTHER ABNORMALITIES IN RICE PANICLES

At the Central Rice Research Institute, Cuttack, while studying the inheritance of some characters in the F_3 generation of certain cross-combinations within the *indica* group of rices, three types of abnormalities in rice panicles were noted in three plants of the population. These are described below.

(a) *Poly-husked Spikelets*.—In the cross W. 703 \times Ac. 1780, one of the panicles in a plant showed the presence of certain spikelets with extra husks (Fig. 1). Of the 33 spikelets on

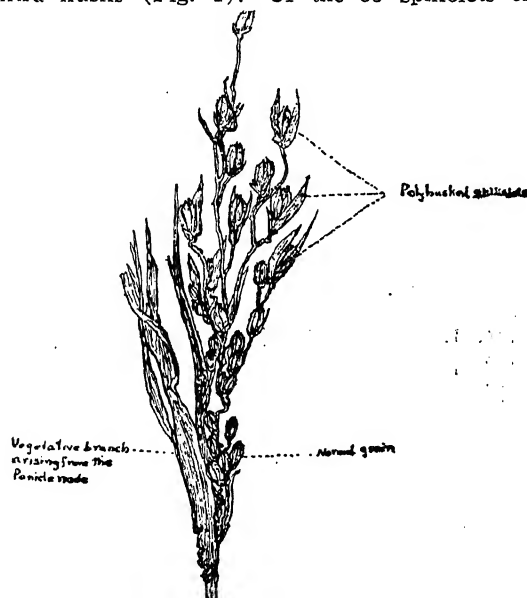


FIG. 1. Diagrammatic representation of panicle with poly-husked spikelets and vegetative branch from the cross W. 703 \times Ac. 1780 (natural size).

this panicle, 14 were poly-husked, 15 were normal and 4 were sterile and filamentous. In the poly-husked spikelets, although the reproductive organs were present (in many cases in reduced condition), none of them bore any seed. The number of extra husks varied from one to five with the mode at three. In size, 20.9% of the extra husks were half as long as the lemma, 41.8% equal to the lemma and 37.3% about one and a half times to twice the length of lemma. In addition to the presence of poly-husked spikelets on the panicle, a vegetative branch consisting of a rosette of thin, short, somewhat curled stiff leaves, arose from the panicle node. Kuang *et al.* (1946) observed a number of poly-husked spikelets on a panicle, both in *japonica* and *indica* groups of rices. These extra husks varied in number from one to five and in size were,

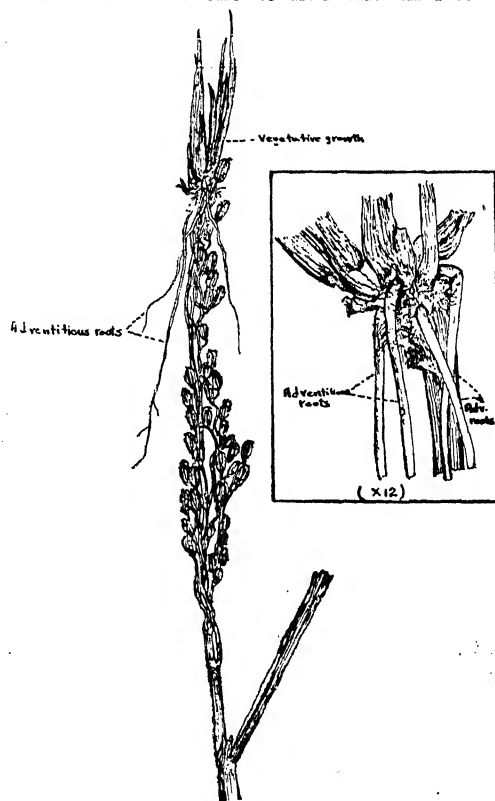


FIG. 2. Diagrammatic representation of panicles with adventitious roots arising from the base of the upper vegetative part from the cross Ac. 1780 \times Ac. 1765 (natural size) [Inset $\times 12$].

same length as lemma, smaller than lemma, or very much longer than the lemma. Jordon (1957) reported the occurrence of an extra long lemma or an extra glume between the lemma and the outer glume in the F_2 of cross 852, and found

this condition to be simple recessive to normal, the same as reported by Kuang *et al.* (*loc. cit.*)

(b) *Adventitious Roots*.—In another cross Ac. 1780 \times Ac. 1765, a number of adventitious roots were found to develop on the upper parts of the panicle (Fig. 2), a few of them measuring 4 to 8.5 cm. in length. They arose from the base of the upper part of the panicle, which had become vegetative and turned into a cluster of narrow stiff leaves. The position of roots arising from this bunch of leaves, was either from the base of the scaly leaves or from in between the scaly leaves (Fig. 2). Jones and Pope (1942) observed panicles with adventitious roots in the X-rayed rice variety *Caloro* and later on, in a panicle of the *Nira* variety. These roots were noted by them to arise in some spikelets, somewhere between the lemma and the abscission layer of the seed, while in others they arose below the first glume. The presence of adventitious roots was found by these authors to be simple recessive to the normal condition.

(c) *Variegated Spikelets*.—A number of variegated patterns have been described and their inheritance studied by various workers. These variegations have consisted of striped patterns confined to the first 2-3 leaves in the seedling stage only. Pal and Ramanujam (1941), however, have described one variegated plant in which the green and white striping persisted in the mature plant and later spread to grains as well. In the cross W. 703 \times Ac. 1780, one plant was found poorly developed and showed striping of white and green, which extended from the leaf-sheath to all other parts of the plant including the panicle and spikelets. The white stripes were rather in excess of the green ones and gave the plant a silvery grey appearance. The panicle was compact, stunted, with a number of small round grains, many of which were sterile.

Seeds have been collected from these abnormal types and have been grown during the current crop season for studying their behaviour and possible utilization in genetical research.

Central Rice Research
Institute, Cuttack,
September 3, 1958.

W. T. BUTANY.
N. R. NAIR.

AN UNDESCRIBED SPECIES OF *CERCOSPORA* ON *ANOGEISSUS* *ACUMINATA* WALL.

GROWING along the bank of the river Mahanadi in the district of Sambalpur, large and beautiful trees of *Phansi* (*Anogeissus acuminata* Wall.) were observed to be infected by apparently an undescribed species of *Cercospora* towards the end of March 1958. The disease appears on the lower surface of the leaves as fuliginous patches of irregular size which often coalesce and involve a major portion of the leaf surface. At a later stage the infected leaves abscise and fall off quite earlier than the unaffected leaves.

Cercospora acuminata spec. nov. (Fig. 1)

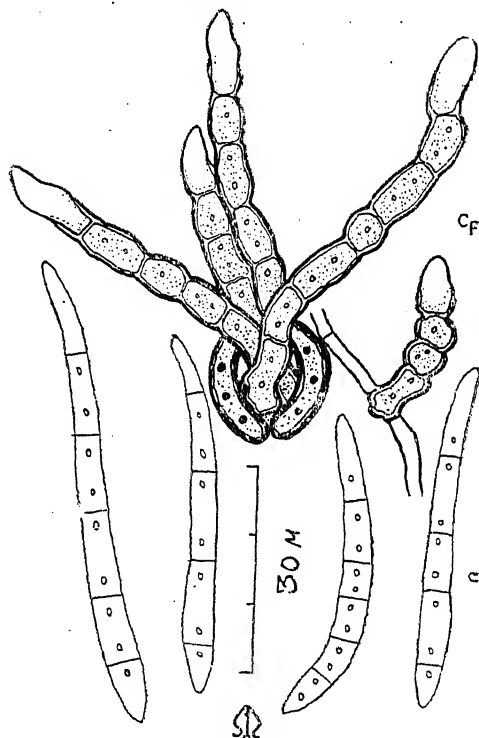


FIG. 1. Conidiophores (*cf.*) and conidia (*c*) of *Cercospora acuminata* Das.

Maculae non distinctae; fructificationes hypophyllae, effusae, circulares vel irregulares, 2-5 mm. diam. saepe coeulescentes, olivaceae; stromata minuta vel nulla; conidiophori crassis parietibus praediti, breves, non ramosi, geniculatione inconspicua, brunnei, pallidiores ad apicem, breviter septati, frequenter constricti ad septa, globulis olei ornati, emergentes per stomata singuli vel fasciculati, stipitibus 2-5. magnitud. 21-57 $\mu \times$ 4.5-5.5 μ (42.6 \times 5 μ); conidia subhyalina, recta vel tenuiter curvata,

1. Jordon, N. E., "Inheritance of some of the more striking characters in rice," *J. Hered.*, 1957, **48**, 181-82.
2. Jones, J. W. and Pope, M. N., "Adventitious roots on panicles of rice," *Ibid.*, 1942, **33**, 55-58.
3. Kuang, H. H., Chiang, Y. H. and Tu, D. S., "Studies on the variation of poly-husks in cultivated rice," (*O. sativa* L.), *J. Genet.*, 1946, **47**, 269-71.
4. Pal, B. P. and Ramanujam, S., "A new type of variegation in rice," *Indian J. Agric. Sci.*, 1941, **11**, 170-76.

bis ad quinquies septata, obconica ad basin, subobtusa ad apicem, olei globulis ornata, magnitud. $27-90 \mu \times 3-4.5 \mu$ ($51.45 \times 4 \mu$).

Typus lectus in foliis *Anogeissus acuminatae* Wall. ad locum Sambalpur die 14 februarii anni 1958 a S. N. Das et positus in herbario collegii agriculturæ in Statu Neo-Eboracensi in Universitate Cornelliana et in herb. *Crypt. Ind. Orient.*, I.A.R.I. in New Delhi (Sub numero acquisitionis 25981).

As far as the author can ascertain, this is probably the first report of *Cercospora* occurring on a member of Combretaceæ. The fungus is, therefore, recognized as a new species and named as *Cercospora acuminata*.

Thanks are due to Prof. C. Chupp and L. R. Batra of Cornell University, U.S.A., for helping in identification; to Rev. Father Dr. H. Santapau, St. Xavier's College, Bombay, for rendering the Latin descriptions and to Dr. U. N. Mohanty, Deputy Director of Agriculture, Cuttack, for his encouragements.

Mycology Research Wing, SITANATH DAS.
Utkal Krushi Mahavidyalaya,
Bhubaneswar (Orissa),
August 28, 1958.

DISCOVERY OF VIRULENT ISOLATES OF RACE 42 B OF *PUCCINIA GRAMINIS TRITICI* IN BOMBAY STATE

THE occurrence of biotypes within the Indian races of stem rust of wheat was first proved by Uppal and Gokhale² who showed that two field isolates of race 42 were entirely different in their pathogenic behaviour from the original culture of that race established by Mehta.¹ The biotype 42 A is differentiated from race 42 by its virulence on Khapli wheat only while the biotype 42 B is differentiated from both by the reactions of Yalta wheat which is highly susceptible to 42 B but resistant to 42 and 42 A.

Stem rust occurred in an epidemic form in parts of Bombay State in 1956-57 when E. 572 (Ridley), an exotic wheat, and selection No. 146 from the cross (Gaza \times Local Baxi 23) were found to be susceptible under field infection although both of them were known to be resistant to the commonly occurring Indian races of stem rust in seedling and field tests. Pure cultures established from the pustules of susceptible type occurring on these varieties proved to be race 42 B. Both E. 572 and selection No. 146 are resistant to the original culture of race 42 B maintained at Mahabaleshwar. E. 572 proved susceptible to the field isolate from that variety but resistant to the isolate

from selection No. 146 and *vice versa*. Similarly, a sample of stem rust on local wheat from Kurkutte in Marathwada Region, which also proved to be race 42 B on differential and accessory hosts, was found to be more virulent to Kenphad wheat than the original culture of race 42 B. These three isolates of race 42 B were, therefore, compared between themselves and also with the original culture of race 42 B by testing some more wheat varieties against all of them in the seedling stage. The results are given in Table I. The new isolates are

TABLE I

Seedling reactions of ten wheat varieties to race 42 B and its three new isolates

Variety of wheat			Race 42 B	New isolates		
				42 B-1	42 B-2	42 B-3
Seedling reactions						
1	Kenphad	28	X	3 and 4	3 and 4	4 and 4
2	do.	39	X	X	X	3 and 4
3	(Gaza × Motia)- 59		2	2	X	2
4	(Gaza × Jaya)- 125		2	2	X (Mostly	2
5	(Gaza × Baxi 23)- 146		2	2	3 and 4)	
					do.	
6	Charter		2	2	3 and 4	2
7	Gaza		2	2	3	2
8	Hybrid 65		2	2	4	2
9	E. 572		2	3 and 4	1 and 2	2
10	Dundee 48		2	3 and 4	2	2

designated as follows: the isolate from E. 572 as 42 B-1, that from (Gaza \times Baxi 23)-146 as 42 B-2 and that from Kurkutte local wheat as 42 B-3.

It will be seen that the isolates 42 B-1 is virulent to E. 572 and Dundee 48 but not to Charter, Gaza, Hy. 65 and selections 59, 125 and 146 from crosses with Gaza as the resistant parent while the isolate 42 B-2 is virulent to varieties which are resistant to 42 B-1. All these eight varieties (Nos. 3-10 in Table I) are, however, resistant to race 42 B. This shows that both the isolates, *viz.*, 42 B-1 and 42 B-2, are not only different from and more virulent than race 42 B but each of them can be regarded as a separate race. The isolate 42 B-3 differs from race 42 B and the two isolates mentioned above only in the degree of susceptibility of two Kenphad wheats. The remaining eight varieties are resistant to both 42 B and 42 B-3. Hence the isolate 42 B-3 may be regarded as merely a virulent isolate or biotype of 42 B and not a separate race.

The discovery of biotypes within Race 42, particularly 42 B, was of great significance to the wheat breeders. The present discovery of more virulent isolates in race 42 B makes their task still more complicated and difficult. Varieties like Charter, Gaza and E. 572 which are resistant to all the commonly occurring races of stem rust in India, including 42 B, are susceptible to one or the other of these new isolates. Till now, Gaza was the only *durum* variety with high or moderate resistance to all the Indian races of stem rust, except 15 C (Gokhale³) which, however, is of rare occurrence. Since Gaza is susceptible to the isolate 42 B-2, the rust resistant selections from crosses between it and the high yielding but rust susceptible improved *durum* wheats of the new Bombay State and Mysore might prove susceptible if that isolate, which was picked up from one of such selections, increases in prevalence.

The discovery of the biotypes and further isolates in race 42 has also an important bearing upon the procedure followed for testing wheat varieties and hybrids for stem rust resistance under artificial epidemics. It is necessary to expose the promising rust resistant varieties or hybrids to natural infection of stem rust at a large number of places, especially where the conditions for the development of infection are quite favourable.

The authors are grateful to Dr. M. K. Patel, retired Plant Pathologist to Government, Bombay State, for his help in the preparation of manuscript.

Bombay,
July 25, 1958.

V. P. GOKHALE.
B. P. PATIL.
M. K. DESAI.

1. Mehta, K. C., *Sci. Monogr. Imp. Coun. Agric. Res.*, 1940, 14.
2. Uppal, B. N. and Gokhale, V. P., *Curr. Sci.*, 1947, 16, 61.
3. Gokhale, V. P., *Ibid.*, 1950, 19, 214-15.

CHROMOSOME NUMBER IN PANDANALES

THE order Pandanales includes the family Pandanaceae, Typhaceae and Sparganiaceae. Of these the chromosome numbers of a few species of *Pandanus* (Tjio, 1948; Harada, 1949), *Typha* (Roscoe, 1927; Heiser & Whitaker, 1948; Harada 1949) and *Sparganium* (Harada, 1949) have been determined. As very little work has been done on the plants occurring in India, belonging to the above three families, the present work was undertaken with a view to work out the anatomy, embryology and cytology of *Pandanus*

utilis, *P. odoratissimus*, *Freycinetia funicularis*,^{*} *Typha angustata* and *T. elephantina*. The following is a preliminary account of the cytology of the plants studied so far. The chromosome numbers determined during the course of the present study are as follows:

TABLE I

Name	Chromosome Number <i>n</i>	2 <i>n</i>
<i>Pandanus utilis</i> Roxb. ..	30	60
<i>P. odoratissimus</i> Roxb. ..	30	60
<i>Freycinetia funicularis</i> Mern.	25	X
<i>Typha angustata</i> Chaub. ..	15	30
		also determined by Harada (1949)
<i>T. elephantina</i> Roxb. ..	15	30

It may be pointed out in this connection that the recorded chromosome numbers of *Pandanus pacificus* & *P. pygmaeus* by Tjio (1948) is the same as determined for the species under study. However, Harada (1949) records $2n = 64$ for *P. boninensis*, and $2n = 30$ for some species of *Typha*. Heiser & Whitaker (1948) also state $2n = 30$ for the different species of *Typha* except *T. angustifolia* L. where they find $2n = 60$.

The chromosomes of both the species are extremely small and exhibit dimorphism. The number and morphology of the somatic chromosome have been studied by prefixing the root-tips in aesculine, coumarine and α -bromonaphthalene followed by aceto-orcin squash method. Salt-chromosomes have been observed in the somatic complement of all the plants investigated. Study of meiosis has been completed. A full account of the cytology of the plants investigated will be presented elsewhere.

The above work was conducted from a grant of the C.S.I.R. and has been carried out under the guidance of Dr. I. Banerji, to whom my grateful thanks are due.

(MRS.) BIDYUT GUNGULY.

Department of Botany,
Calcutta University,
Calcutta,
August 20, 1958.

* Material was kindly handed over to me by Prof. P. Maheshwari, which was collected from Java.

1. Harada, I., *Cytologia*, 1949, 14, 214.
2. Heiser, C. B. Jr. and Whitaker, T. W., *Amer. J. Bot.*, 1948, 35, 179.
3. Roscoe, M. V., *Bet. Gaz.*, 1927 a, 84, 392.
4. Tjio, Joe Hin, *Hereditas*, 1948, 34, 135.

REVIEWS

Royal Society Mathematical Tables, Vol. IV. (Tables of Partitions.) By Hansraj Gupta, C. E. Gwyther and J. C. P. Miller. (Cambridge University Press.) Price 3 £ 3 sh. net.

The theory of the partition of integers into different parts is one of the most beautiful branches of Number Theory and finds application in diverse subjects like combinatory analysis, group theory and statistical mechanics. In the present tables, values are given for $p(n, m)$ which is the number of partitions of n into at most m parts, and three other functions $p_2(n, m)$, $p_3(n, m)$ and $p_4(n, m)$ which are defined only mathematically and are given by the relations

$$\sum_{n=0}^{\infty} p_s(n, m) t^n = \prod_{r=1}^m \frac{1}{(1-t^r)^s} \prod_{r=m+1}^{\infty} \frac{1}{(1-t^r)^{s-1}}$$

($s=1, 2, 3, 4 \dots$)

The tables are preceded by an introductory chapter explaining the symbols used, their interconnections and the methods adopted for the computation of the functions, and an excellent bibliography for the subject of partitions of numbers. The introductory chapter reads as a good introduction to the subject of partitions itself and supplies formulæ for $p(n, m)$ for three different cases, namely, (1) when m is comparable with n ; (2) when n is small and (3) in the asymptotic case of large values of n . When $m=0$, the last case reduces to the asymptotic expansion for $p(n)$, the number of unrestricted partitions of n into integers which is a problem solved by Hardy and Ramanujan in one of their famous papers. Table I tabulates the values of $p(n, m)$ in the first instance for values of m from 1 to 100 and of n from 1 to 200, and secondly when $n > 200$, for all values of m from 1 to 50 and for n up to 400. Table II gives the values of $p_2(n, 0)$ [$p(n)$] for values of n up to 1,000 and the values $p(n, m)$ for small values of m . Table III tabulates the function $p_3(n, m)$, and in Table IV are given the values of $p_4(n, 0)$ or $p_3(n)$ for integral values of n up to 200.

The tables would prove to be beneficial to all scientific institutions wherein the programme of work calls for the numerical application of partition functions. The authors and publishers deserve to be congratulated for bringing out

this edition which is a product of arduous labour and excellent printing workmanship.

K. S. VISWANATHAN.

Nuclear Scattering. By K. B. Mather and P. Swan. (Cambridge University Press, London N.W. 1), 1958. Pp. viii + 469. Price 80 sh.

The subject of nuclear scattering has recently been exhaustively reviewed in several volumes of the *Handbuch der Physik*. Those who want a briefer account of this topic will welcome this book in the series of Cambridge Monographs on Physics. It deals mainly with the scattering of nucleons by nucleons and very light nuclei, where it is possible to investigate the detailed form of the nuclear two-body interaction.

Chapter 1 introduces concepts of nuclear physics necessary for an understanding of nuclear scattering. Chapters 2 to 4 are devoted to general experimental methods and are discussed only in the special context of scattering technique. This is more or less a review and adequate references are given to the original papers. Chapter 5 contains graphs of range-energy relations for charged particles in various materials, and will serve as a ready reference.

Two chapters are devoted to the theory of low-energy neutron-proton and proton-proton scattering and introduces the well known concepts of effective range and scattering length. In this region there is excellent agreement between theory and experiment. A further chapter discusses the low-energy scattering of nucleons by very light nuclei. The introduction of more particles makes calculations much more difficult and the authors show that the work done so far is inexact and incomplete. It becomes necessary to take into account the non-central interactions, namely, the tensor and the spin-orbit interactions which are important, for example, in the scattering of nucleons by α -particles.

This is followed by two chapters on high-energy scattering. The discussion of this work leads to no definite conclusion about the details of the nucleon-nucleon interaction but the method of approach given here has been followed in the recent very important work of Signell and Marshak, and Gammel and Thaler. In this section the deuteron stripping reaction is introduced and reviewed in some detail,

Many other related topics are discussed briefly, for example, nuclear saturation, meson theory of nuclear forces, the optical model and the Breit-Wigner dispersion formulæ. Considering the size of the book, the account is quite comprehensive. It is well illustrated with diagrams and figures, and has a very complete list of references. It will be very useful to research workers and post-graduate students, but the price (80 sh.) is rather high.

G. A.

Rockets, Missiles and Space Travel. By Willy Ley. (Chapman & Hall, London W.C. 2 ; India : Asia Publishing House, Bombay-1), 1957. Pp. xv + 528. Price 50 sh.

This book is a useful contribution to the rapidly increasing library on 'Conquest of space' literature.

A good half of the book is devoted to the historical background and chronological development of Rockets. Starting from the time of the Babylonians, the author describes in an elaborate and yet interesting manner the evolution of modern Rocketry.

This book should particularly interest those who believe that a combination of suitable rocket fuels and a rocket motor will make a flight to the Moon possible within the near future. However, to those who may deem it all that simple, the author's personal experience in the enormous technical problems which face teams engaged in Rocket Research, in the Chapters 'Peenemunde' and 'White Sands' (the two famous rocket research centres) will be immensely educative. Any project on rocket research involves the automatic functioning of a host of different components and the failure of even a single component in the System dooms to failure the whole project. Therefore, checks, rechecks, counter-checks must be applied first and last at all stages of the development programme. A clear insight to problems like escape velocity, exhaust velocity, mass ratio, etc., which are very important in the launching of a rocket is given in the Chapter, "The Rocket into Cosmic Space". In the Chapters "The Shot Around the World" and "The Spaceship", the future possibilities and uses of launching of future artificial satellites both unmanned and man-manned are described.

The book was published in March 1957 and so does not include the successful launching of the artificial satellites. Of course, as the author himself expresses, with the rapid progress done in this field, one cannot expect a book of this type to be up-to-date. Neverthe-

less information on rocket research done till the early days of 1957 has been adequately covered.

In conclusion, with the evolution of the Rocket Airplane admirably described in Appendix I, the useful notes, tables and diagrams—of which there are 84—the book attains substantial reference value, besides being useful and instructive to both the specialist and non-specialist alike.

B. M. C.

Polymer Reviews—The Effects of Ionizing Radiation on Natural and Synthetic High Polymers. By Frank A. Bovey. (Interscience Publishers, New York), 1958. Pp. xiii + 287. Price \$ 8.00.

This volume is the first of a series of reviews to be published on subjects of lively and topical interest in polymer science. The choice of the radiation chemistry of high polymers as the first in the series is quite appropriate. Apart from the technological and theoretical interest, the subject is linked up inextricably with the problem of human welfare. In the light of the continuous radioactive pollution of earth's atmosphere by nuclear explosions and the general awakening throughout the world to the genetic hazards of radiations, the importance of the subject can never be over-emphasised.

The volume begins with a concise and balanced treatment of radiochemistry which is followed by an introduction to the chemical effects of radiations. Against this essential background, a general account of the radiation chemistry of high polymers is presented in the third chapter. The principal reactions induced by radiations namely scission and cross-linking and the statistical methods of treating the phenomena constitute the subject-matter of the succeeding chapter. This is followed by a detailed presentation in six chapters the results of the extensive investigation of the physical and chemical changes brought about by radiations on synthetic and natural polymers. The diverse types of synthetic polymers are grouped together under different heads from the standpoint of structure such as hydrocarbon polymers, acrylics, halogenated polymers, diolefin polymers and condensation polymers. The natural polymers and their derivatives are given a separate treatment in the last chapter. No knowledge of the structure of the polymeric materials is presupposed on the part of the reader and prior to the presentation of radiation chemistry a brief account of the structure of the polymer is also given. This undoubtedly

enhances the utility of the book and would interest a wider class of readers. Another notable feature of the book consists in the presentation of the radiation chemistry of small molecules structurally related to polymers, as a prelude to the discussion of the radiation chemistry of the polymer. This approach proves to be of immense efficacy in stressing upon the nature and the type of interaction of the vulnerable sites of the macromolecule with radiation.

The volume is a critical and competent survey of one of the rapidly advancing fronts in polymer science and is a welcome addition to the existing treatises on the subject. The author has presented much scattered and even some of the inaccessible information in a very concise and readable manner. As the first of the series, it has set up an excellent standard and one would wish that the succeeding volumes of the series keep up the standard of the first volume.

The printing is excellent and free of mistakes.

S. L. KAPUR.

Number Average Molecular Weights. By Robert U. Bonnar, Martin Dimbat and Fred. H. Stross. (Interscience Publishers, New York, London), 1958. Pp. 310. Price \$ 7.50.

The determination of molecular weights of solutes is a common routine laboratory experiment described in texts for undergraduates. Since Beckmann's classical experiments, for a considerable time very little beyond refinements in techniques found their way into textbooks. Except under osmotic pressure, the monograph on Physical Methods of Organic Chemistry does not give an adequate treatment and the volume under review fills a gap. The study of compounds of high molecular weights has revealed often considerable differences between different methods and a monograph dealing with all the methods including viscosity average and weight average (centrifugal) methods would have been desirable. The present volume is of strictly restricted scope dealing only with the number average methods alone.

The subject is dealt in eight chapters starting with an introductory survey with cryoscopic, ebullioscopic, osmotic pressure, vapour pressure, vapour density and functional group methods each forming a chapter and the theory of the first two methods forming a separate chapter.

Every chapter gives a clear picture not only of the conditions to be fulfilled for precision measurements but also the pitfalls in each case.

Where alternative procedures are adopted, we see a critical appreciation of these so that an investigator can make his choice. The cryoscopic method rightly emphasises the factors which vitiate experimental results and amongst them is one not commonly mentioned in the routine texts: reduction in solubility of a solute by the presence of another apparently inert substance. The chapter on ebullimetry is complementary to that of Swieteslowski in *Techniques of Organic Chemistry* and we have a useful account of using this procedure in determining molecular weights up to 20,000. The volume is specially valuable for a thorough discussion of the theory of these methods. Following Lewis and Randall, expressions are derived which lead to the need for not only the conventional cryoscopic or ebullioscopic constant but second and third terms in the integrated form of the Clapeyron equation. Where precision measurements are needed, one has to know precisely the errors involved and the basis on which these can be eliminated. The fourth chapter gives us a very useful picture of this aspect.

Under vapour pressure lowering methods, both thermoelectric and isopiestic methods are described. The reviewer is unable to agree with the author that Barger's method of isothermal distillation 'was novel and not very accurate'. As a micromethod, with very simple equipment, this method gives as accurate values as many others with more complicated equipment. The last two chapters give a brief account of recent techniques in vapour density and functional group methods.

The book is well produced and both the contents and the treatment make it a valuable addition to any laboratory training students of Physical Chemistry.

S. V. A.

Organic Electrode Process. By Milton J. Allen. (Chapman & Hall Ltd., London), 1958. Pp. xi + 174. Price 32 sh.

The author has given a lucid account of the techniques of Electro-organic Chemistry and has discussed in detail the factors affecting the course of organic oxidations and reductions brought about by the influence of electric current. The reduction of nitro compounds, of imines and imidic esters, aldehyde and ketones, carboxylic acids, esters, amides and imides as well as some complicated systems such as alkaloids, aliphatic-substituted compounds,

sulphamated compounds, unsaturated compounds etc., are all discussed. Similarly the oxidation of aliphatic acids and their salts with special reference to Kolbe reaction, oxidation of alcohols, aldehydes, ketones, sugars, carboxylic acids, alicyclic compounds, etc., are also discussed in detail. A chapter is devoted towards anodic substitution reactions. A perusal of the subject-matter as well as the references shows that the book is rather outdated since there appears to be but scanty references to the work done during the last decade, with the result that some of the important developments have not been included in the book.

The presentation of the subject-matter is satisfactory with very few errors.

K. S. G. D.

Methods of Biochemical Analysis, Vol. VI.
Edited by Glick. (Interscience Publishers,
New York), 1958. Pp. ix + 358. Price \$ 9.50.

Methods of Biochemical Analysis, the sixth one of the annual series, is now published. It is a most welcome addition which has quite maintained the tradition of previous volumes, so far as the wealth of materials and the varieties of newer techniques and methods dealt with in this volume are concerned. The volumes published uptill now really constitute a "self-modernizing encyclopædia" of methods of biochemical analysis. The progress of science depends considerably on the development of newer techniques and the refinement of the older ones already in use. That is why so much emphasis is given now-a-days on the methodology and instrumentation for all branches of science.

The current volume covers a variety of methods including physical, microbiological, chromatographic, electrophoretic, etc., for the determination, mostly in micro amount of the important biochemical constituents, particularly nucleic acid, serotonin, enzymes, vitamins, etc. Of exceptional importance is the procedural details of the different methods given in the book which are not always available to the workers interested in them. The contributors of this volume are either pioneers or have personal experience in the development of the methods they have discussed. So it is needless to add that a book with such a stamp of authority will be most welcome to all biochemists and other workers in the allied branches of science.

M. C. NATH.

Irrigation and Hydraulic Design (Vol. II)—
Irrigation Works. By S. Leliavsky. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xiv + 864. Price 294 sh.

The author has attempted to write a comprehensive treatise covering all aspects of irrigation and hydraulic design in three volumes. Volume I deals with general principles of hydraulic design, Volume II with designing and planning of perennial canal schemes, and theory of irrigation works including regulators, cross-drainage works, siphons, weirs and other canal structures from the smallest to the gigantic sizes. The third volume which is to be shortly published will deal with all types of sizes of diversion works, on alluvial rivers and electrification of irrigation works.

Dr. Leliavsky has undertaken this stupendous task single handed. His experience covers over 40 years which includes service with the Russian Government on the Hydroelectric Works of the Dnieper Project and the Irrigation Department of the Egyptian Government.

The second volume begins with a chapter on design of regulators of all sizes. The Egyptian practice has been discussed thoroughly. The discussion on the hydraulics of the flow of the water from the weirs has been thorough from purely theoretical point of view. As is well known, mere mathematics cannot give a correct answer in many cases and the author could have stressed on the usefulness of model studies. Under such conditions, model studies alone can give a dependable answer.

In the chapter dealing with the hydraulic works, a reference could have been made to what in India are called Relieving Weirs to dispose of the surplus water from canals. The practice of having intermediate regulators, and cross-canals is not in vogue in this country. As the author has rightly pointed out, this induces other troubles like those of silting and encouragement of weed growth, while it may be helpful in maintaining a good head at the tail end. While discussing the various types of falls, it has been correctly pointed out that the hydraulic ideal would be satisfied if the water level over the crest of irrigation work would vary precisely in the same manner as in the canal it controls. Thus for every discharge slope, the canal should remain the same, so that, all the outlets whether at the head or at the tail of the canal takes its appropriate share of irrigation water in all conditions. The Indian design of notch type of falls approaches

this ideal to the greatest extent possible (p. 334). In this respect, the American designs mentioned require further improvement. While discussing the design of automatic siphon spillways, the author is apparently not aware of the recent work done in India. The world's biggest siphons each 18 feet diameter of the Ganesh Iyer's type are working efficiently at the Mahatma Gandhi Hydroelectric Works in Mysore State. The important point to be considered with the design of siphon is the priming depth in relation to the diameter of the siphon. This has not been discussed. Another point that could have been discussed is the limitation of the height of the siphon barrel at the crest. The discharge in a siphon is not increased proportionately with the increase in the diameter of the siphon barrel at the crest. The author has done well in describing clearly the Prasil's flow net diagrams for fixing the exact shape of the trajectory flow over the spillway. This knowledge is very useful as the reviewer does not know of any other book dealing with this important subject. The author has made a statement that to reproduce cavitation in a model, the zero pressure must be taken equal to the vapour pressure p_v . He gets the equation:

$$p_a' = p_v + \frac{p_a - p_v}{n}$$

The problem for scaling down is not as simple as that. Experiments have shown that cavitation depends on the solid-gas-nuclei content of the water. It is not known whether any correlation exists at all between Reynolds Number of the flow and inception of cavitation in the turbulent region of the flow. It is not possible to obtain a functional relationship between model experiments and prototype performances with our present knowledge of cavitation phenomenon. It should also be understood that cavitation damage is not scalar. While discussing the characteristics of the spillway flow, the author has stressed only on the design of the spillway free from any negative pressure. This restricts the coefficient of discharge over the weir. It is well known that the discharge for the same length of the weir can be increased by designing a weir (as has been successfully done by the reviewer) with negative pressure at the crest and these are called high coefficient weirs in India. As long as the pressures are above cavitation pressures, there need be no fear of vibrations or other instability problems. While designing a perennial irrigation scheme, the various anti-malarial measures necessary have also to be considered.

In India, it has become a standard practice to leave a margin of a furlong or so round every village where cultivation is restricted for only dry crops. This is done to prevent water-logging in the villages coming under the command of the canals. Soil surveys and crop planning data are also necessary for designing of a perennial irrigation scheme.

The few remarks made above are intended to make the future editions of the book even more useful. The treatment of the subject has been thorough both from the historical and the analytical points of view. This is a book which every irrigation engineer ought to possess. The book contains well over 700 diagrams, charts and tables. The price, considering its excellent get-up and its value to designers, is not too high.

N. S. GOVINDA RAO.

Isotopic Tracers in Biology—An Introduction to Tracer Methodology, Third Edition. By Martin D. Kamen. (Academic Press, Inc., Publishers, New York; India: Asia Publishing House, Bombay-1), 1957. Pp. 474. Price \$ 9.50.

It must have been immensely satisfying to Dr. Kamen, the co-discoverer of Carbon-14, to watch the field of research pioneered by him and a few others to expand and cover a vast territory including many disciplines of scientific research.

The first edition of this book came out in 1947 when isotopic tracers were a novelty in many laboratories. It was immediately accepted as a standard text-book for the frontier science of tracer methodology. The popularity of the isotopes in biological research grew exponentially in the following years and a second edition had to be brought out in 1951. The third edition has long been overdue.

"The objective", as the author puts it, "of this third edition is the same as those defined in the first edition. The main task in preparing it has been to evaluate new material covering many aspects of a number of fields, some not even mentioned in the first edition. I am tempted to borrow the diplomatic phrase 'agonizing re-appraisal' to describe the difficulties inescapable in such a process."

In fact, the author has packed together an unbelievable amount of material within a book of a comparatively small size and as a result, the current edition, apart from attaining its obvious objective, meets the requirement for a supplementary text-book for subjects, such as biology, physiology, biochemistry and medicine,

The most impressive section of this book comprises of three chapters on the survey of tracer methodology in which the application of tracers in biological processes has been reviewed. After dealing with the principles and limitations of the tracer technique, the author proceeds on to diverse subjects, such as the dynamic state of cell constituents, the concept of metabolic pool, precursor-product relationships, metabolic cycles, isotopic competition, Ogston's hypothesis about the stereospecificity of the enzymes of the Krebs cycle, reversibility of biochemical-equilibria and the mechanism of enzyme reactions.

In the next chapter a masterly treatment is given to three selected topics in intermediary metabolism, *viz.*, the pathway of carbon dioxide in photosynthesis, the biosynthesis of cholesterol and the biosynthesis of porphyrins, the elucidation of which can be regarded as the outstanding achievements of tracer research.

Dr. Kamen in his brief but sparkling review has been able to recreate the thrills and excitement marking these great events in biochemistry.

In the third part of this section a wide cross-section of material has been presented in connection with the applications of tracers in physiology, immunology, chemotherapy and medicine.

The reviewer fails to understand the significance of putting the last four chapters dealing with the chemistry of various isotopes at the end of the book. These should have been brought forward to follow the first three chapters—where they logically belong.

An unfortunate and probably unwitting lapse from the high standard maintained throughout the book is the structure of DPNH given on p. 176. The formula for DPNH as shown was accepted up to 1954 but has undergone revision since 1955. However, the third edition has not only kept up to the standards set by the previous editions but also has surpassed them in many respects.

P. K. BHATTACHARYA.

mics—the breadth and usefulness of which implied in the first and second laws.

This book is intended to meet the needs engineering students in thermodynamics. The book is divided into two parts. Part I which consists of seven chapters deals with basic thermodynamic principles. The various terms are defined clearly and adhered rigidly throughout. The First and Second Laws of thermodynamics and their applications are logically and lucidly discussed. The general thermodynamic equations are derived and tabulated.

In Chapter 4, the behaviour of perfect and real gases is treated. While compressibility factor is dealt with, no mention is made of "Amagat Unit". Irreversible processes and actions between systems of constant weight and systems of variable weight are next dealt with. This latter is of considerable engineering importance.

In Part II is dealt Flow Processes. The flow of fluid through a plant may be steady or unsteady flow, *i.e.*, variable with respect to time. The latter is not treated in this book. The mechanics and thermodynamics of steady flow processes in view of its engineering importance are presented in great detail. The usual steady flow cycles such as Carnot, Rankine, Regenerative, Reversed, divided and multiple fluid cycles are uniquely treated in a single chapter enabling the student to a better appreciation of the same. A chapter each has been devoted to prime movers of engineering importance, *viz.*, steam turbine, steam engine and compressors. Refrigeration and liquefaction of gases form the concluding two chapters.

A noteworthy feature of the book is a brief discussion in Appendix I of the methods used in the determination of Thermodynamic properties.

The get-up of the book leaves nothing to be desired. This well-written book is a welcome addition to the numerous text-books on Thermodynamics.

A. S.

Thermodynamics of One Component Systems.

By W. N. Lacey and B. H. Sage. (Academic Press Inc., Publishers, New York; India: Asia Publishing House, Bombay-1), 1957. Pp. xi + 376. Price \$ 8.00.

Among engineering sciences thermodynamics is the oldest. The analysis and design of specific engineering systems require a comprehensive appreciation of the varied facets of thermodyna-

Chemotherapy and the Central Nervous System.

By Henry McIlwain. (J. A. Churchill 104, Gloucester Place, London W. 1), 1957. Pp. viii + 328. Price 45 sh.

Dr. McIlwain's book *Chemotherapy and Central Nervous System* is an expensive volume and is probably meant to be used as a text-book by students to learn some of the outstanding facts on chemotherapy with reference to Central Nervous System. It is did-

in its tone and has a bibliography attached to each chapter; most of the references are from among the English authors. The historical anecdotes given in the various chapters of the book are interesting and give a picture of the advances that have been made during the course of time by authors working with different approaches in trying to understand the problems of chemotherapy. These anecdotes can also be fairly easily remembered.

The subject has been discussed in twelve chapters; there is also an author and subject index. The accepted formulæ of many of the drugs now in use have been presented, perhaps, to show the possibility of synthesis of some of these drugs; the specific action of any one part of the molecule is, however, not indicated. The last two paragraphs of each chapter show, in a summary form, the work done so far towards the specific chemotherapeutic processes and the possible lines of advance of knowledge that might take place in the coming years. The assay of many of these chemotherapeutic drugs during the metabolism in the human body are indicated but are not given in sufficient detail, for which other books and the works of other authors have to be consulted. The graphs shown in many of the chapters are simplified to reveal and to impress the memory of the results that have been obtained by various authors during their experimentation on chemotherapeutics.

The typing and format are excellent. The publishers have, as usual, given an excellently bound book. There seems to be no typographical errors.

The book can well be recommended to any post-graduate student for understanding various aspects of neuro-chemistry and the approach towards the treatment and chemotherapeutic measures evidenced by the vast quantity of work that has been done during the last few years. The author is to be congratulated on producing a very valuable textbook in a field in which there is not much available literature, presented in an easily understandable form.

M. V. GOVINDASWAMY.

A Revision of the Genus *Camellia*. By J. Robert Sealy, Royal Botanic Gardens, Kew. (Published by the Royal Horticultural Society, Vincent Square, London S.W.1), 1958. Pp. 240. Price 3 £ 10 sh.

Students of the tea plant will welcome the publication, by the Royal Horticultural Society, of J. Robert Sealy's *A Revision of the Genus*

Camellia. Mr. Sealy has been engaged on this for nineteen years and it fully justifies the labour. As exquisite colour plate by Stella Ross-Craig draws attention to the horticultural possibilities of the genus. Species are illustrated by drawings notable for their clarity and of great value to the taxonomist. Descriptions of the species in this difficult genus are presented for the first time in a convenient and accessible form. Special attention is given to the tea plant. More than one species has made its contribution to cultivated tea, and the taxonomic affinities given by Sealy must necessarily be taken into account by specialists, botanical and otherwise, who wish to extend our fundamental knowledge of this important crop. The format of the book maintains the high standard expected of the publishers: one hopes that its reception in India will be followed by a national collection of living specimens that might, in time, rival the camellias of the Huntington Gardens in America.

W. WIGHT.

Enzymes in Blood (*Annals of the New York Academy of Sciences*, Vol. 75, Art 1). (New York Academy of Sciences), 1958. Pp. 384.

This volume is a collection of papers presented at a Conference held by the New York Academy of Sciences in February 1958. The stated objective of the volume is to "increase the contact between clinical investigators of blood enzymes and members of other groups, such as enzymologists and physical chemists, so that... each might gain in understanding and some increased ability for his own investigations". More than eighty participants report their latest findings under five major headings: Enzymes in White Blood Cells, Enzymes in Red Blood Cells, Enzymes in Blood Coagulation and in Platelets, Serum Enzymes and their Origin, and Clinical Significance of Blood Enzymes. Time and space do not permit a detailed coverage of the material (which took two days to present). It ranges from "Leukocyte glycolysis: an investigation of the Factors Controlling the Rate Behaviour in Multienzyme Systems" by William S. Beck to "Immunochemical Studies on Alkaline Phosphatase" by Max Schlamowitz, with papers on Carbohydrate, Protein and Nucleic Acid Metabolism and Blood Coagulation sandwiched in between.

So wide is the coverage of subject-matter that any scientist with any biochemical propensity whatever will find much to interest him. The volume is well edited and will be

a very worthwhile addition to the bookshelf of the biochemist and clinician.

T. RAMAKRISHNAN.

The Indian Zoological Memoirs. [Monograph No. 6 on The Indian River Prawn, (*Palæmon*)]. (Published by the Zoological Society of India). Pp. 102. Price Rs. 5.0.

The issue of a second edition of the Indian Zoological Memoir on the Indian River-Prawn, *Palæmon*, though long overdue since its first publication in 1937, will be warmly welcomed by students and teachers of Zoology in the steadily increasing numbers of Universities and Colleges in the country. It is to be hoped that when a revised edition of the Memoir is contemplated, the following will be borne in mind: the addition of a key to the Indian species of *Palæmon* and of a separate chapter on Embryology, and the enlargement of Chapter XII on Bionomics and Distribution. A short bibliography of essential literature referred to in the text on the subject-matter of the Memoir may prove to be a useful addition.

The price of the Memoir is reasonable considering that the quality of printing and get-up equals that of the contents.

H. S. R.

Books Received

Nuclear Magnetic Resonance. By H. S. Gutowsky, F. C. Nachod and others. (*Annals of New York Academy of Sciences*, Vol. 70, Art 4.) Pp. 763-90.

Gypsum and Anhydrite. By A. W. Groves. (H.M. Stationary Office, London S.E. 1), 1958. Pp. iv + 108. Price 7 sh. 6 d.

Metals and Enzyme Activity. Edited by E. M. Crook. (Cambridge University Press, London N.W. 1), 1958. Pp. 102. Price 21 sh.

Cosmic Electrodynamics. By J. W. Dungey. (Cambridge University Press, London N.W. 1), 1958. Pp. ix + 184. Price 32 sh. 6 d.

Scientific Uses of Earth Satellites. By J. A. Van Allen. (The University of Michigan Press; India: Asia Publishing House, Bombay-1). Pp. x + 316. Price \$10.00.

The Exploration of Space by Radio. By R. H. Brown and A. C. B. Lovell. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1957. Pp. xii + 207. Price 35 sh.

Instrumentation in Testing Aircraft. By C. N. Jaques. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1957. Pp. xi + 291. Price 45 sh.

Report for 1957, Rothamsted Experimental Station, Harpenden, Herts. (Rothamsted Experimental Station, Harpenden, Herts), 1958. Pp. 316. Price 10 sh.

Space Exploration. By P. Moore. (Cambridge University Press, London N.W. 1). Pp. 36. Price 3 sh.

Modern Geometrical Optics. By M. Herzberger. (Interscience Publishers, New York-1), 1958. Pp. xii + 504. Price \$15.00.

Mind and Matter. By Erwin Schrodinger. (Cambridge University Press, London N.W. 1), 1958. Pp. vii + 104. Price 13 sh. 6 d.

Gas Turbines for Aircraft. By A. W. Judge. (Chapman & Hall, London W.C. 2), 1958. Pp. vii + 439. Price 60 sh.

Science and Education at the Cross Roads. By J. W. Still. (Public Affairs Press, Washington 3 D.C.). Pp. viii + 140. Price \$3.75.

Progress in Crystal Physics, Vol. 1. By R. S. Krishnan. (S. Viswanathan Central Art Press, Acton Lodge, Madras), 1958. Pp. vi + 198. Price Rs. 20.

Solving the Scientist Shortage. By D. C. Greenwood. (Public Affairs Press, Washington 3 D.C.). Pp. viii + 68. Price \$2.00.

Adventures in the World of Science. By C. G. Abbot. (Public Affairs Press, Washington 3 D.C.). Pp. ix + 150. Price \$3.50.

Proceedings of the Symposium on Ground Water. (Central Board of Geophysics, Calcutta-16), 1955. Pp. xvi + 400.

Advances in Enzymology, Vol. 20. Edited by F. F. Nord. (Interscience Publishers, New York-1, N.Y.). Pp. vii + 488. Price \$12.50.

Patterns of Discovery. By N. R. Hanson. (Cambridge University Press, London N.W. 1), 1958. Pp. ix + 240. Price 30 sh.

General and Inorganic Chemistry for University Students. By J. R. Partington. (Macmillan & Co., London W.C. 2). Pp. xxiii + 927. Price 60 sh.

Integral Equations.—Cambridge Tracts in Mathematical Physics. By F. Smithies. (Cambridge University Press, London), 1958. Pp. vii + 172.

SCIENCE NOTES AND NEWS

National Institute of Sciences of India

Applications are invited for the undermentioned Research Fellowships. The Fellowships are tenable for two years at any University or Institution in India. Particulars and application forms are obtainable from the Secretary, National Institute of Sciences of India, Mathura Road, New Delhi 1. Request for forms should be accompanied by a self-addressed and 25 nP. stamped envelope of 9" × 4" size, indicating thereon the name of the Fellowship for which forms are required. Four copies of application on prescribed form should be sent. Copies of published papers as evidence of research and an outline of the proposed scheme of research are to be submitted with each application form. Closing date for receipt of applications is 7th March 1959.

National Institute of Sciences Senior Research Fellowships.—The value of the Fellowship is Rs. 500 p.m.; in addition, Rs. 1,000 is available for approved expenses per year. Age: Below 45 years. **Qualifications Essential**—(i) Master's Degree in Science of a recognised University. (ii) Experience of independent research.

National Institute of Sciences Junior Research Fellowships.—The value of the Fellowship is Rs. 400 p.m.; in addition, Rs. 600 is available for approved expenses per year. Age: Below 35 years. **Qualifications Essential**—(i) Master's Degree in Science of a recognised University. (ii) Research Experience.

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board Fellowships for the year 1959 have been awarded to the following candidates: (Miss) B. N. Uma, Indian Institute of Science, Bangalore-3; Prafulla J. Dave, Haematology Clinic, J.J. Group of Hospitals, Byculla, Bombay-8; G. V. G. Krishna Rao, Nutrition Research Laboratories, Coonoor; Anil R. Sheth, Indian Cancer Research Centre, Parel, Bombay-12; Kshitish Chandra Das, Institute of Post-Graduate Medical Education and Research, Calcutta-20.

Award of Research Degrees

The University of Bombay has awarded the Ph.D. Degree in Botany to Shri T. R. Thyaga-

rajan for his thesis entitled "Cytological Phenomena Succeeding Spoilation in *Saccharomyces carlsbergensis*".

The Gujarat University has awarded the Ph.D. Degree in Physics to Shri K. M. Kotadia of Physical Research Laboratory, Ahmedabad, for his thesis entitled "Studies in Ionospheric Physics in Low Latitudes".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri V. Ananthrao Saraf for his thesis entitled "Studies in Isomerization and Conjugation of Some Drying Oils", and the Ph.D. Degree in Biochemistry to Shri M. S. Naik for his thesis entitled "Studies in Riboflavin in Higher Plants".

Osmania University has awarded the Ph.D. Degree in Physics to Messrs. M. Ramakrishna Rao, M. Suryanarayana and Bansigir K. Goswami for their theses entitled "Light Scattering and Viscosity Studies of Some Polymer Solutions", "Ultrasonic Studies in Chemically Active Liquid Media" and "Photo Elastic Dispersion in Crystals" respectively.

Indian Botanical Society

The following have been elected as Office-bearers for the year 1959: President—Dr. E. K. Janaki Ammal, Allahabad; Vice-Presidents—Dr. R. Misra, Banaras, Dr. P. Maheshwari, Delhi; Hony. Secretary—Dr. J. Venkateswarlu, Waltair; Hony. Librarian—Dr. R. Misra, Banaras; Hon. Treasurer and Business Manager—Dr. T. S. Sadasivan, Madras.

The Indian Society of Genetics and Plant Breeding

At the 19th Annual General Meeting of the Indian Society of Genetics and Plant Breeding, held on 23rd January 1959, at New Delhi, the following were elected as Office-bearers of the Society for 1959: President—Dr. R. H. Richharia, Vice-Presidents—Dr. A. B. Joshi, Prof. P. N. Bhaduri; Secretary—Dr. M. S. Swaminathan; Treasurer—Dr. N. L. Dhawan; Editor—Dr. B. P. Pal.

International Conference on Semiconductor Physics in Prague, 1960

Czechoslovak Academy of Sciences organizes International Conference on Semiconductor

Physics which will be held in Prague from 29th August to 2nd September 1960 under the auspices of the International Union for Pure and Applied Physics and which will continue the series of Conferences held in Reading 1950, Amsterdam 1954, Garmisch-Partenkirchen 1956 and Rochester 1958.

The Secretary of the Organization Committee has the following address: Dr. Milos Matyas, Institute of Technical Physics, Prague 5, Cukrovarnicka 10, Czechoslovakia.

The Indian Society of Theoretical and Applied Mechanics

At the Fourth Congress of the above Society which was held at the Bengal Engineering College, Howrah, from December 29 to 31, 1958, the following Office-bearers were elected: President (for 2 years): Dr. A. N. Khosla; Vice-President (vice Sri. V. Cadambe retired): Dr. S. K. Chakravarty; Secretary and Treasurer (for 3 years): Prof. B. R. Seth. New Members of the Executive Committee: Dr. Jai Kishan, Prof. B. Sen Gupta and Prof. D. Banerjee.

Standardization of Columns for Gas-Liquid Chromatography

At the International Symposium on Modern Methods of Analytical Chemistry, held at the Louisiana State University, January 26-29, 1959, Dr. B. Sen, who has been a Visiting Assistant Professor at Louisiana State University for four years, discussed critically the recommendations of the second symposium on Gas Chromatography. The standardization of columns in gas-liquid chromatography is a matter of considerable importance and the existing methods are extremely complicated to perform. He showed that by reproducing the chromatogram—a representation of Bernoulli trials—the total number of trials and the probability of success can be predicted and so the column conditions can be specified. Based on his theoretical work substantiated by experimental data, Dr. Sen told that the new technique, which does not involve any kind of correction factor, may be considered as an absolute means of standardization.

The Fluorocarbons

Till some ten years ago relatively few carbon-fluorine compounds were known, but in the past decade many hundreds of them have been synthesised by a variety of methods. They are based on the chemical combination of carbon with fluorine and are closely related to the carbon-hydrogen systems of orthodox organic chemistry.

However, whereas the hydrocarbons are highly inflammable, fluorocarbons are extremely non-inflammable and are unusually chemically stable. This is because the bond between carbon and fluorine atom is an extremely strong one and also because the size of a fluorine atom is not too great to allow saturated fluorocarbon chains to exist without causing undue strain in the molecule.

In such compounds, fluorine atoms shield the backbone of carbon atoms and thus protect them from attack by chemical reagents; this factor contributes to the great stability of the fluorocarbons, which are indeed almost unreactive as the rare gases. They will resist attack by strong acids, alkalies, oxidising and reducing agents, and a great commercial future is possible for them for this reason. Many closely related compounds containing carbon, fluorine and either chlorine and/or bromine are excellent fire extinguishers and they have revolutionised the refrigeration and aeronautical industries. This is due in part to their great chemical stability and the ease of handling them under slight pressure.

A remarkable method of fluorination of organic compounds has been developed by the American chemist Simons and his colleagues. The organic compound to be fluorinated is dissolved in anhydrous hydrogen fluoride and electrolysed at voltages below those necessary for the liberation of free fluorine. Fluorinated carbon compounds with a typical functional group have readily been made; for example, fluorocarbon carboxylic acids, sulphonic acids, ethers and tertiary amines which are of great potential importance.

In recent years an intensive study has been made by Dr. Tatlow, and his students, on the fluorination of benzene. This compound was fully fluorinated to give perfluorocyclohexane, C_6F_{12} . However, in addition to the fully fluorinated materials it is possible to synthesize fluoro-hydrocyclohexanes, cyclohexenes, cyclohexadienes. Chemical processes are available to enable the remaining hydrogen atoms in a hydrofluorocyclohexane or hexane to be removed and the important compound fluorobenzene, C_6F_6 , has been synthesised. preparative techniques have been rapidly developed so that this important compound is now available in significantly large quantities and its reactions are being compared with those of benzene. It will be readily apparent that the vast number of carbon-ring-containing "aromatic" compounds already known may be paralleled with an equally large number of hexafluorobenzene aromatic compounds. Alr

the fluorophenols, fluoroanilines and fluorodyc-stuffs have been synthesised. The discovery of fluorobenzene is of particular significance in the biological field, because every biologically important compound containing a benzene ring will in due course have its fluoro analogue. Perhaps the greatest potential use for the fluoro-compounds will be in making fluoro-rubbers and fluoro-plastics of high chemical and thermal stability. Yet another important application will be in the field of the silicones, where the replacement of certain of the hydrogen atoms by fluorine atoms gives a "fluorosilicone rubber" which is more resistant to heat and to conventional fuels than are the silicones. In the days to come in this age of ever faster-flying aircraft with higher "skin temperatures" there will be an increasing demand for non-inflammable construction materials of every description.

From the university teacher's point of view, fluorocarbon chemistry provides excellent discipline in synthesis and theoretical reasoning for the training of young research chemists.—Prof. Maurice Stacey, F.R.S., in *The New Scientist*, January 8, 1959.

Blow-Hole Theory of Lunar Craters

In the light of the recent discovery reported by the Russian astronomer of a volcanic eruption on the moon (*Current Science*, 1958, 27 (12), p. 512) the following observations of Gaydon and Learner (*Nature*, January 1959, 183, p. 37) will be of great significance. They suggest the possibility of lunar craters being caused by fountains of dust blown out by trapped gas.

Many years ago Dr. Gaydon observed that during rapid evacuation of a quantity of magnesium carbonate in a flask a number of blow-holes appeared as the occluded gas escaped, leaving a pattern of rings, some with central 'pimples', closely resembling lunar craters. After the recent announcement of the volcanic activity on the moon, they repeated the experiment using a variety of powders (sand, salt, magnesium oxide or magnesium carbonate) in a 5-litre flask, which was continuously evacuated; a small flow of air was admitted at the bottom of the flask by a small hole. Various forms of blow-hole, which simulated lunar craters, were observed. The form of the 'crater' varied with type of powder, its angle of slip, depth, and the rate of flow of gas.

It is known that terrestrial volcanoes may emit large quantities of dust and ash, but the presence of an atmosphere interferes with the free fall of the particles. On the moon with no atmosphere, lower gravity, and probably a

dry 'sandy' surface, formation of the craters, with or without a central peak as the blow-out peters out, seems possible. The escape of gas trapped beneath the moon's loose 'sandy' surface would not necessarily require the high sub-surface temperatures associated with volcanic activity. Further it has recently been shown that shock-wave excitation of CO, CO₂ or CH₄ produces C₂ swan emission bands. Hence the reported C₂ emission spectrum from the 'Alphonse' crater may not necessarily indicate that the gas has a very high initial temperature.

Acoustoelectricity

The generation of an electric voltage in germanium by the passage of a very high frequency sound wave is being studied by G. Weinreich, of Bell Telephone Laboratories. The "Acoustoelectric" voltage difference appears along the direction of propagation of the wave, and is due to a net force forward acting on the charge carriers (electrons for example) within the germanium.

The effect is usually small, because of the normal electric repulsion between the carriers bunched by the wave. Examination of the conditions in which the effect is more marked sheds light on the energy states of the electrons in the germanium. Weinreich uses acoustic waves of 20 and 60 Mc./s. modulated at a much lower frequency to produce a fluctuating voltage output.—*The New Scientist*, January 8, 1959.

Molecular Sieves

Some of the naturally occurring mineral zeolites, such as analcite and chabazite, as well as some synthetic zeolites have in them an array of minute holes or micropores which are precisely of the same size which is comparable with the cross-section of organic molecules. These materials are known as molecular sieves because molecules of organic compounds, particularly hydrocarbons, having certain critical dimensions smaller than the pores of the zeolite, are capable of diffusing *into the pores* and remaining adsorbed while other hydrocarbons with larger dimensions cannot enter the pores and are merely adsorbed *upon the surface*. The critical dimension which controls the entry of the molecule is the largest diameter normal to the longest axis of the molecule. This for *n*-paraffins of moderate chain length is of the order of 5 Å, and Barrer has shown that by using a zeolite with pores of this size, *n*-paraffins may be separated quantitatively from their branched chain isomers which have a significantly larger cross-section. Other hydrocarbons

such as *cyclo*-paraffins, and aromatics are also too large to enter the pores and so can be separated from the *n*-paraffins. Commercial molecular sieves, of synthetic zeolites and silica powders, known as *sepa-gels* are now available in a range of pore sizes 4, 5, 10 and 13 Å, and are being used in organic molecular separation.

The technique is similar to conventional adsorption chromatography. The mixture of aromatics is allowed to flow slowly down a column packed with the molecular sieves adsorbent. This is followed by an elution with *iso*-octane which removes from the column those constituents which have not been adsorbed into the micropores. The portion which had suffered pore-adsorption may be desorbed by washing with a polar solvent such as ethanol at 75° C. Thus the original mixture of aromatics is separated into two fractions according to size, the smaller appearing in the ethanol eluate and the larger in the *iso*-octane eluate.

Other applications of molecular sieves are in gas chromatography and mass spectrometry where they may selectively restrict the entry of molecules into the instruments. (*Chemical Products*, January 1959.

Crude Oil Analysis Using Nuclear Reactor

Crude oil contains certain elements, such as vanadium, which are known to "poison" certain steps involved in petroleum refining. Generally the amount of these elements present in the crude oil is so small that the usual chemical methods of measuring them not only take time but also tend to depreciate in value because the supposedly pure test chemicals themselves contain enough of the unwanted elements to make the measurement unreliable. The Reactor method at the University of Michigan is arrived at permitting speedier and more accurate detection of such elements.

In this method a sample of the crude oil is sent through a pneumatic tube to the core of the reactor where in minutes it becomes radioactive. It is returned in a few seconds through the pneumatic tube for chemical analysis. The sample is immediately placed in a unique 100 channel analyzer, equipped with dual "memory", in which the radioactivity of the sample influences the instrument to draw a graph which will "finger-print" the element under investigation. A comparison of this "finger-print" with known

graph of suspected elements will indicate the presence as well as the amount of the element in the crude oil.—*J. Frank. Inst.*, November 1958.

Pilobolus—the Fungus with a "Lens"

Phototropism, or the response to light, is common place in the plant world, but few more elegant examples are to be found than in the life of *Pilobolus*, the tiny 'ball-thrower' fungus. Growing on the droppings of grazing animals, the plant develops overnight and, by dawn, glistening colonies are found on the surface of the dung bits,—each individual composed of a delicate stalk (about quarter inch long) and a transparent, swollen subsporangium which is topped by the black 'ball' of its spore case. At sunrise, the swollen cell acts as a lens that concentrates light on a pigmented area of the stalk, and accelerated growth bends the plant toward the sun. Simultaneously, the pressure within this "lens" builds up—to as much as five atmospheres—until the cell bursts, casting the spore case as far as eight feet away. The flying 'ball' usually lands on a grass blade—to be eaten and voided by some grazing animal, whereupon *Pilobolus*' life-cycle starts once again.—*Natural History*, December 1958.

Ultrasonic Fatness Tests on Live Pigs

What is claimed to be an accurate, humane and simple method of measuring the thickness of fat on the back of live pigs is by the use of an ultrasonic probe. An ultrasonic sound wave is sent through the back fat of the pig, and on reaching the boundary between the fat and lean tissues, it is reflected back to the surface. The time taken for the sound waves to go through the fat and back again is a measure of the fat thickness. The ultrasonic probe which is placed on the pig's skin contains two barium titanate crystals. One sends out sound waves and the other receives the echo. The transmitting crystal is made to vibrate by the application of high-frequency electrical pulses of 2.5 Mc./s. The receiving crystal picks up the echo and converts the sound to electrical pulses. The crystals are connected by long leads to the main instrument where the transmitted and reflected pulses are amplified and displayed as narrow peaks on a cathode ray tube. The distance between peaks is proportional to the fat thickness.—*J. Frank. Inst.*, November 1958.

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CHRISTIAAN HUYGHENS AND THE WAVE THEORY OF LIGHT: Part II

SIR C. V. RAMAN

5. THE WAVE-OPTICS OF HUYGHENS

BEFORE proceeding to comment on the writings of later authors on the work of Huyghens, we may usefully here summarise the basic concepts of his theory. Huyghens put forward and sought to establish the proposition that when a wave of light diverges from its source, every small portion of the wave is capable of propagating itself independently with the same velocity as the rest of it; in an isotropic medium, the direction of such propagation is the wave-normal and hence this is also the direction of the ray in the sense of geometrical optics. The same idea forms the basis of Huyghens' explanation of the reflection and refraction of light. When the elements of area of an advancing wave-front reach the boundary between two media, each such element gives rise, respectively in the two media, to the elements of area in the reflected and refracted waves. These latter advance normally to themselves in such a direction that they can join up and form continuous wave-fronts. The geometric constructions employed by Huyghens enable these requirements to be satisfied. The propagation of light in an inhomogeneous medium considered in the fourth chapter of Huyghens' treatise can also be very simply dealt with on the same basis. The elements of area of the wave-front in such a medium advance normally to themselves with the velocity appropriate to their positions in the medium. As they advance, they join up to form new wave-fronts which are orthogonal to the path of the light-rays in the medium.

Later writers have criticised the arguments employed by Huyghens in his treatise. One remark which is often made is that the theory of Huyghens would result in his wave-fronts moving backwards as well as forwards and that he had given no explanation for the absence of backward propagation. But this criticism is not justified and is itself based on a misunderstanding. Huyghens was concerned with the behaviour of an *advancing* wave-front in a homogeneous medium. The partial waves which in his theory give the observed light intensity by their superposition are those which diverge from points lying on the straight line between the source and the observer; in order to reach the observer simultaneously they should all move *away* from the source and *towards* the point of observation, in other words move

forwards towards the observer. The possibility of backward propagation is thus ruled out completely.

Another criticism which has frequently been advanced is that the theory of Huyghens is based on an arbitrary assumption, *viz.*, that only along the envelope of his partial waves would there be any observable intensity of light. This criticism is also based on a misunderstanding. It should be remembered that Huyghens was unaware that the waves of light are periodic disturbances having a definite wave-length. He assumed that light consists of *individual* waves which diverge in all directions from the original source and the partial waves contemplated in his theory would therefore also be of the same nature. The build-up of a finite intensity from the superposition of a very large number of such waves, each of which is *extremely* feeble, would accordingly be possible only if they arrive *simultaneously* at the point of observation. The diagram appearing in the first chapter of Huyghens' treatise is intended to assist the reader to appreciate the arguments set out in the text; *viz.*, at *each* point on the wave-front a great number of partial waves arrive *simultaneously* and build up the intensity at that point, while the entire wave may be itself considered as made up of a great number of elementary areas at which the light-intensity has thus been built up. In the later chapters in which Huyghens' theories of reflection and refraction and of the propagation of light in an inhomogeneous medium are expounded, the diagrams are intended to exhibit how the complete wave-front arising from these processes is built up out of its elementary parts or areas. Here again, the final result is an individual wave, and it may therefore be correctly described as the envelope of the partial waves which co-operate in building it up.

6. THE PARTIAL WAVES OF HUYGHENS

Since the concept of partial waves introduced by Huyghens in his treatise has played an important role in physical optics, it is appropriate that we consider it here in some detail. Though the words appear in several chapters of his treatise, it should be remarked that they do not have the same significance in each case. In the first chapter which seeks to explain the rectilinear propagation of

light, the partial waves arise as a consequence of the assumed discrete structure of the luminiferous medium; each particle in the medium is regarded as a source of such waves. In the second and third chapters, the partial waves are assumed to arise when the primary wave reaches the boundary separating the two media with different properties. The elements of area of the boundary are here regarded as the source of partial waves. Since they travel with different velocities, they are distinct from each other in the two media. In the fourth chapter which deals with the propagation of light in inhomogeneous media, the partial waves are assumed to diverge from the elements of area of the advancing wave-front in such a medium.

If the luminiferous medium were empty space, the assumption that it consists of discrete particles which can function as emitters of partial waves would be difficult to justify. In the case of material media, however, there is good reason for assuming that the discrete atoms of which they are composed could function as sources of secondary or partial waves. Even so, however, these partial waves would reinforce each other in the direction of propagation of the primary wave and merge with it, while in other directions they would interfere and cancel out each other's effects. Thus, they would, in all cases, cease to be observable. Accordingly, the notion of partial waves can, in such circumstances, be regarded only as hypothetical or virtual and not as an observable or physical reality. The same remarks would also be applicable in regard to the propagation of light in a medium which is inhomogeneous. Indeed, as already remarked, this particular case could be dealt with in a very simple manner without making any use of the concept of partial waves. Thus, finally, we are left with the phenomena arising from the incidence of light on the boundary between two material media. Huyghens' construction explains the geometric laws of reflection and refraction in so natural and convincing a fashion that it is difficult to resist the conclusion that his concept of partial waves is well-grounded and is a physical reality in these particular cases.

7. THE SO-CALLED PRINCIPLE OF HUYGHENS

It will be evident from what has been said above that the ideas of Huyghens were not correctly understood or appreciated by later writers. It is not surprising therefore that the whole of the vast literature which was subsequently published and which claims to base

itself on the ideas of Huyghens, in reality proceeds on a different basis altogether. This is evident from the fact that the mathematicians whose objective was to develop a "Rigorous Formulation of the Principle of Huyghens" concerned themselves with precisely the case in which Huyghens' concept of partial waves has no physical meaning or justification, namely the undisturbed propagation of waves from a source situated in a structureless and uniform continuum.

The well-known formula developed by Kirchhoff is an illustration of the foregoing remarks. Here, the disturbance due to the source at the point of observation is expressed as an integral taken over the area of a closed surface within which the point of observation is included but not the source. Each elementary area of the surface appears in the formula as a source from which waves diverge with amplitudes which vary with the direction of emission. The line joining the source and the point of observation is also the direction of maximum amplitude for the waves radiated by the element of area which lies on that line *between* them, and of zero amplitude for an element of area which also lies on the same line but on the *opposite side*. Kirchhoff's formula as actually developed refers to the case of sound-waves, and the attempts made to extend it to the case of light have not met with success. But our present concern is not with the mathematics of the formula but with the physics of the subject. The association of the formula with the name of Huyghens—honoured as the founder of the wave-theory of light—has naturally disposed whole generations of physicists to look upon it with favour. It has, however, been made clear by the foregoing remarks that Kirchhoff's approach to the subject is quite different from that of Huyghens. We have, therefore, to ask ourselves: Is Kirchhoff's formula really meaningful? Has it any claim to validity or acceptance considered from the standpoint of optical theory? We shall proceed to consider these questions.

As has already been remarked, one of Huyghens' striking successes is his explanation of the geometric laws of reflection and refraction. His concept of partial waves takes its clearest and most acceptable form in this case, *viz.*, that each element of area of the physical boundary acts as a source of partial waves. Since these move with different velocities in the two media, they should be considered as

distinct. In other words, the partial waves in each medium are hemispherical, and it becomes a meaningful physical problem to determine the dependence of the amplitude of the waves with direction on the surface of these hemispheres. It would presumably be a maximum in the direction of the normal to the boundary and zero in directions parallel to the boundary. On the other hand, the very generality of Kirchhoff's formula indicates that it has no physical validity or significance. For, it is not possible to discover or assign any reason why an element of area set at an arbitrary orientation

in a continuous structureless medium should function as a source of secondary waves with specific features related to that orientation. If the concept of partial or secondary waves is at all to be meaningful, the waves should have a physically recognizable origin, e.g., a local discontinuity in physical properties. In its absence, the formula ceases to have any physical content. Kirchhoff's formula thus reveals itself to be a mathematical abstraction which is not relevant or valid in relation to the actual problems of physical optics.

LUNAR CRATERS CAUSED BY COMETARY COLLISIONS

THE reported observation by Kozyrev of emission bands of carbon molecule in the lunar crater Alphonsus [see *Curr. Sci.*, 1958, 27 (12), 512 and 1959, 28 (2), 93] has reopened the age-old problem of the origin of lunar craters and lunar plains, and the dilemma between the volcanic and impact theories of their origin confronts us in a new form. Zdenek Kopal suggests (*Nature*, 183, p. 169, Jan. 17, 1959) that any theory of lunar surface features restricted to a consideration of impacts of solid bodies only is bound to remain seriously incomplete, and should be generalized by taking account of the effects which could be wrought on the lunar face by collisions with cometary heads.

According to the impact hypothesis most lunar craters were formed by solid bodies (meteorites, or asteroids) impinging on the Moon with cosmic velocities. It has been calculated that kinetic energies of the order of 10^{28} ergs are necessary to produce impact craters of 80 miles in diameter (like Alphonsus). Such an impinging solid would penetrate at least a few hundred yards into the lunar crust before total vaporization and ejection of crater walls by explosion. This would produce a "moonquake", characterized by a very shallow epicentre, with about one half of the kinetic energy converted into seismic waves.

The latest survey of earthquakes shows that the largest and the most destructive of them experienced so far entailed an energy release of 10^{25} ergs only—i.e., one thousandth of the hypothetical 'moonquake' which might have

caused Alphonsus crater. Considering that there are of the order of 10^5 craters of diameter varying between one mile and 150 miles on the visible half of the Moon alone, it is difficult to explain how any steep mountains or ridges anywhere on the Moon could have survived such a long series of sudden and devastating disturbances.

It is known that comets are at least as frequent at a distance of 1 A.U. from the Sun as are meteorites or asteroids of comparable masses. The wide distribution of cometary orbital elements is bound to render their high-velocity collisions (in the range 30-70 km./sec.) with the Moon much more frequent than would be the case with the asteroids. Moreover, cometary heads made up of loose conglomerates of mainly frozen hydrocarbons with an appreciable mixture of unstable chemical compounds will on impact behave like high explosives—thus releasing chemical energy in addition to the kinetic energy of the head as a whole. Not being solid, the impact of cometary heads would not penetrate too far into the crust of the Moon and produce destructive seismic waves. The heat produced by the impact explosion will be sufficient to melt the local lunar matter into fluid lava, thus explaining the origin of lunar maria.

It may be suggested that the gas discharge observed by Kozyrev may be an accidental release of some gas deposited there by cometary impact at a distant time in the past.

CONFOUNDING IN ASYMMETRICAL FACTORIAL DESIGNS IN RELATION TO FINITE GEOMETRIES

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THE problem of confounding in the general symmetrical factorial design s^m , where s is a prime positive integer or a power of a prime and m any positive integer, was solved by Bose and Kishen¹ by representing each treatment combination by a finite point of the associated m -dimensional projective geometry PG (m, s) constructed from the Galois field GF (s) and using linear spaces or flats represented by linear equations in m variables. This method is not applicable to the problem of confounding in the general asymmetrical factorial design $s_1 \times s_2 \times \dots \times s_m$, where s_1, s_2, \dots, s_m are not all equal. A new method of tackling this problem has, therefore, been developed by using curvilinear spaces or hypersurfaces and truncating the EG (m, s) suitably, and is briefly described in this note.

2. It is well known that all non-zero elements of GF (s) satisfy the equation

$$x^{s-1} = 1 \pmod{\theta(x)}, \quad (1)$$

where $\theta(x)$ is a minimum function for GF (s), of which the elements are denoted as usual by $\alpha_0, \alpha_1, \alpha_2, \dots, \alpha_{s-1}$. This suggests that for reducing the levels of any factor in an s^m design from s to 2, we have to take the corresponding variable raised to its $(s-1)$ -th power. Consider, now, the asymmetrical factorial design $s^{m-1} \times 2$, in which each of the first $m-1$ factors is at s levels and the m -th factor is at 2 levels. Here we truncate all the points, $(s-2) s^{m-1}$ in number, lying on the $s-2$ parallel $(m-1)$ -flats given by

$$x_m = \alpha_r \quad (r = 2, 3, \dots, s-1) \quad (2)$$

We are then left with $s^{m-1} \times 2$ points in the EG (m, s) thus truncated, which exactly correspond to the $s^{m-1} \times 2$ treatment combinations of the asymmetrical factorial design $s^{m-1} \times 2$. Consider, now, the pencil of hypersurfaces of $(s-1)$ -th order represented by the equations

$$x_1 + \alpha_{j_2} x_2 + \dots + \alpha_{j_{m-1}} x_{m-1} + \alpha_{j_m} x_m^{s-1} = d_r \\ (j_2, \dots, j_{m-1} \text{ fixed}; r = 0, 1, \dots, s-1) \quad (3)$$

On each member of this pencil of hypersurfaces lie $s^{m-2} \times 2$ points, to which correspond $s^{m-2} \times 2$ treatment combinations of the asymmetrical design $s^{m-1} \times 2$. The $s^{m-2} \times 2$ treatment combinations corresponding to the $s^{m-2} \times 2$ points lying on a hypersurface may be called the set of treatment combinations corresponding to that hypersurface. The pencil of s hypersurfaces, therefore, divides the totality of $s^{m-1} \times 2$ treatment combinations into s sets of $s^{m-2} \times 2$ treatment combinations each, which, when assigned to s blocks, provide one replication of the asymmetrical design $s^{m-1} \times 2$ divided into s blocks of $s^{m-2} \times 2$ plots each, partially confounding $s-1$ degrees of freedom for the $(m-2)$ -th order interaction $A_1 A_2 \dots, A_{m-1}$ represented by the pencil

$$x_1 + \alpha_{j_2} x_2 + \dots + \alpha_{j_{m-1}} x_{m-1} = \alpha_r \\ (j_2, \dots, j_{m-1} \text{ fixed}; r = 0, 1, \dots, s-1) \quad (4)$$

and also partially confounding the corresponding $s-1$ degrees of freedom belonging to the $(m-1)$ -th order interaction $A_1, A_2, \dots, A_{m-1}, A_m$.

Keeping j_2, \dots, j_{m-1} fixed in (3) and varying j_m from 1 to $s-1$, we get $s-1$ pencils of s hypersurfaces each, which provide all the $s-1$ replications for a balanced asymmetrical confounded design for $s^{m-1} \times 2$ treatment combinations in s blocks of $s^{m-2} \times 2$ plots each. In case balance on other contrasts of $s-1$ degrees of freedom each belonging to the $(m-2)$ -th order interaction A_1, A_2, \dots, A_{m-1} is required, $s-1$ replications corresponding to each such contrast will also have to be included, so that for achieving complete balance on all the $(s-1)^{m-2}$ contrasts, each carrying $s-1$ degrees of freedom belonging to the $(m-2)$ -th order interaction A_1, A_2, \dots, A_{m-1} , $(s-1)^{m-1}$ replications would be necessary.

3. Consider for example, the $3 \times 3 \times 2$ design in 3 blocks of 6 plots each, obtained by taking $m = 3$, $s = 3$. Denote the three factors by A (0, 1, 2), B (0, 1, 2), C (0, 1). In EG (3, 3), we truncate the 9 points lying on the plane $x_3 = 2$. This leaves 18 points in this geometry corresponding to the 18 treatment combinations in the $3 \times 3 \times 2$ design. Here the two replications for the balanced design confounding 2 degrees of freedom for AB and 2 degrees of freedom for ABC are represented by the pencil of surfaces

$$\left. \begin{aligned} x_1 + x_2 + x_3^2 &= 0, 1, 2 \\ x_1 + x_2 + 2x_3^2 &= 0, 1, 2 \end{aligned} \right\} \quad (5)$$

This is the balanced design given by Yates² in which AB (J) and ABC (J) are partially confounded.

For achieving complete balance on AB, we have to take two more replications represented by the two pencils of surfaces

$$\left. \begin{aligned} x_1 + 2x_2 + x_3^2 &= 0, 1, 2 \\ x_1 + 2x_2 + 2x_3^2 &= 0, 1, 2 \end{aligned} \right\}, \quad (6)$$

which by themselves give a balanced design partially confounding AB (I) and ABC (I).

Similarly, when we take $m = 3$, $s = 5$ in (3), we obtain the balanced confounded $5 \times 5 \times 2$ design in 5 blocks of 10 plots each. For achieving balance on any contrast carrying 4 degrees of freedom for the first order interaction between the first two factors and the corresponding 4 degrees of freedom for the second order interaction, we require 4 replications, and for achieving complete balance, we require 16 replications. Other balanced asymmetrical confounded designs are readily derivable by this method by giving particular values to m and s .

4. Balanced asymmetrical confounded designs of the type $s^{m_1} \times 2^{m_2}$, where $m_1 + m_2 = m$, in s blocks of $s^{m-1} \times 2^{m-1}$ plots each, can be constructed by generalization of the method given in Section 2. From EG (m , s), we truncate all the points lying on the $(m-1)$ -flats represented by

$$\left. \begin{aligned} x_{m_1+1} &= \alpha_r \quad (r = 2, 3, \dots, s-1) \\ x_{m_1+2} &= \alpha_r \quad (r = 2, 3, \dots, s-1) \\ &\dots\dots\dots \\ x_m &= \alpha_r \quad (r = 2, 3, \dots, s-1) \end{aligned} \right\} \quad (7)$$

This leaves $s^{m_1} \times 2^{m_2}$ points to which correspond one-to-one the $s^{m_1} \times 2^{m_2}$ treatment combinations of the asymmetrical design. A

design achieving balance on the contrast carrying $s-1$ degrees of freedom for the (m_1-1) -th order interaction $\Lambda_1, \Lambda_2, \dots, \Lambda_{m_1}$ and the corresponding contrast carrying $s-1$ degree of freedom belonging to the interaction of the first m_1 factors with the remaining m_2 factors, is then given by the $(s-1)$ pencils of hyper-surfaces

$$\begin{aligned} x_1 + \alpha_{j_2} x_2 + \dots + \alpha_{j_m} (\alpha_{j_1} x_{m_1} + \alpha_{j_{m_1+1}} x_{m_1+1}^{s-1} \\ + \dots + \alpha_{j_m} x_m^{s-1}), \quad \alpha_r \quad (j_2, \dots, j_m \text{ fixed}; \\ \lambda = 1, 2, \dots, s-1; \\ r = 0, 1, \dots, s-1) \end{aligned} \quad (8)$$

Balance is, therefore, achieved in $(s-1)$ replications.

5. Different types of balanced asymmetrical confounded designs can be derived from an s^m design by raising the elements of GF (s) to different powers and by also forming their linear combinations $\alpha_0 + \alpha_1 x + \alpha_2 x^2 + \dots + \alpha_{s-1} x^{s-1}$, $\alpha_0, \alpha_1, \dots, \alpha_{s-1}$ belonging to GF (s). Thus when s is a prime number p ($p > 2$),

$$(p-k)^2 \equiv k^2 \pmod{p}, \quad (9)$$

Consequently, by squaring the $p-1$ non-zero elements of GF (p), we get only $p-1$ distinct elements corresponding to the squares of the first $p-1$ non-zero elements $1, 2, \dots, (p-1)/2$ of GF (p). This suggests that for reducing the levels of one or more factors from p to $(p+1)/2$, we have to take pencils of surface with each of the corresponding variables squared up. From a p^m design, therefore, and the corresponding geometry EG (m , p), we can derive balanced confounded designs of the type $p^{m_1} \times \binom{p+1}{2}^{m_2}$ in p blocks of $p^{m_1-1} \times (p+1)^{m_2}/2$ plots each, balance on any contrast carrying $p-1$ degrees of freedom belonging to the interaction of the first m_1 factors, besides its corresponding interaction with the other m_2 factors, being achieved in $(p-1)$ replications. Balanced confounded designs of the type $p^{l_1} \times$

$\binom{p+1}{2}^{l_2} \times 2^{l_3}$, where $l_1 + l_2 + l_3 = m$, can be derived by a similar procedure.

6. By a generalization of the results given above, we can obtain balanced confounded designs of the type $s^{m_0} \times s_1^{m_1} \times s_2^{m_2} \times \dots \times s_t^{m_t}$ (where $g_0 = 1$ and $g_0 = g_1 + \dots + g_t = m$) in s blocks of $s^{m_0-1} \times s_1^{m_1} \times s_2^{m_2} \times \dots \times s_t^{m_t}$ plots each,

By a further generalization of this method, balanced confounded designs of the type $s_1^{m_1} \times s_2^{l_2} \times \dots \times s_p^{l_p}$ in s^k blocks of $s_1^{m_1-k} \times s_2^{l_2} \times \dots \times s_p^{l_p}$ plots each ($k \leq m_1$; $m_1 + l_2 + l_3 + \dots + l_p = m$) can be constructed.

7. The method of truncated finite geometries, with pencils of hypersurfaces to represent replications, developed in this note is a valuable tool in the construction of balanced asymmetrical confounded designs of the type considered and opens up a wide class of problems connected

with the construction and analysis of these designs. Full details of the results obtained will be reported in a separate communication.

1. Bose, R. C. and Kishen, K., "On the problem of confounding in the general symmetrical factorial Design," *Sankhya*, 1940, 5, 21-36.
2. Yates, F., *The Design and Analysis of Factorial Experiments*, Imperial Bureau of Soil Science, Technical Communication No. 35, 1937.

U.S. MOON ROCKET PIONEER IV

ON March 3, 1959, U.S. launched the four-stage Juno II rocket from the Cape Canaveral missile test centre (Florida). It carried as its nose-cone the 13.4 pound, gold plated space probe, Pioneer IV, designed to pass close to the moon and hurtle millions of miles beyond to become an artificial planet orbiting the sun. Like the Soviet "Lunik" launched just two months earlier on January 2, 1959 (see *Curr. Sci.*, 1959, 28, 47). Pioneer IV had exceeded the second cosmic speed and become the second man-made planet to go round the sun, along a nearly similar orbit. It carried a small transmitter and scientific instruments to measure the extent of radiation in outer space. The giant radio-telescope at Jodrell Bank, Manchester, had tracked Pioneer IV on three successive mornings since its launching and the data received till the time contact was lost with it had been recorded on 12 miles of tape.

Within 4 minutes of the launching, radio-signals from the rocket were picked up by the radio tracking station on Long Island, New York. At 16.00 hrs. GMT the probe was 84,800 miles away from the earth. At 08.45 hrs. GMT on March 4, the Jodrell Bank Observatory reported that Pioneer IV was more than 180,000 miles away from the earth and that signals were still being received quite clearly and that its position could be calculated. At 22.24 hrs. GMT on March 4, Pioneer IV by-passed the moon at a distance of 37,771 miles from it which was more than 17,000 miles further away than had originally been planned.

A pair of photoelectric cells were installed in Pioneer IV which, in addition to their own experimental function, could be triggered by the moon's light. Although they could operate within 20,000 miles of the moon, they could not function at 35,000 miles from it and hence the plans for the probe to announce its own arrival in the moon's vicinity could not be fulfilled.

At 05.36 hrs. GMT on March 5, when Jodrell Bank contacted it again, Pioneer IV was more than 280,000 miles away, already "bang on orbit" as a planet. Data received on telemeter were "not of high class" but "a bit jumpy and not as sound as they should be".

On March 6, at 13.00 hrs. GMT Jodrell Bank lost contact with Pioneer IV when it was more than 405,000 miles away.

The Goldstone tracking station in California lost contact with it at about 15.24 hrs. GMT on March 6. The last signals came from a point deeper in space than any transmission previously recorded.

Pioneer IV's last known position was given as 406,020 miles from the earth when it was travelling at 3899 miles per hour. The batteries of the transmitter were assumed to have run out a few hours after Jodrell Bank lost contact with Pioneer at 13.00 hrs. GMT on March 6. Prof. A. C. B. Lovell, Director of the Observatory said that if the rocket's batteries had had a longer life, the telescope would easily have tracked it to 4 million miles.

HISTORY OF MATHEMATICS*

THE enterprise of the Dover Publications in republishing the well-known work of David Eugene Smith in an unaltered and unabridged form is heartily to be commended. The work appears in two volumes. They are pleasant to handle, easy to read and are modestly priced. The preface states that the work was written for supplying teachers and students with usable text-books on the history of elementary mathematics. Actually, it is a work of very general interest since it deals with one of the fundamental aspects of the development of human thought. Indeed, the work can be justly regarded as a worthy contribution to the history of the cultural progress of mankind.

The first volume considers the history of mathematics chronologically. In ten chapters, the whole field is covered, beginning with prehistoric mathematics followed by the contributions of the ancient civilisations of China, India, Babylon, Egypt and then the work of the early and the later Greeks down to 500 A.D. In the next three chapters the contributions of the eastern world in the medieval period are reviewed alongside those of Europe. In the later chapters, the European countries naturally take the pride of place.

The second volume considers the development of mathematics in terms of specific fields and problems. We shall here simply reproduce the chapter-headings: Development of the Arithmetica, Logistic of Natural Numbers, Mechanical Aids to Calculation, Artificial Numbers, Geometry, Algebra, Elementary Problems, Trigonometry, Measures, and finally, the Calculus.

The subject has been handled by the author in such manner that the reader's interest is sustained throughout. The illustrations of the book are well chosen and indeed fascinating. Side by side with the portraits of the great mathematicians of the past, we have specimens of their handwriting, illustrations from the title page of their books, pictures of their instruments, models, maps and sketches of various kinds. The author has brought to bear on his work a remarkable breadth of vision combined with scholarly erudition. No country which has contributed to the growth of mathematics is ignored. No mathematician of any note is forgotten. The author also does not omit to take note of developments in fields closely related to mathematics, e.g., astronomy and physics.

In short, one may say that the perusal of the book is an enjoyable experience. It should find a place in the library of every institution which teaches mathematics and of every individual who is interested in the story of its development.

C. V. R.

* *History of Mathematics*. By David Eugene Smith. (Dover Publications, Inc., 920, Broadway, New York), 1958. Price of the complete set (Volumes I & II): \$5.00.

Volume I. General Survey: 167 Illustrations; bibliography; 21 page Chronological Table; Index. Pp. xxii+596. Price: \$2.75.

Volume II. Topical Survey: 329 Illustrations; Index. Pp. xii+725. Price: \$2.75.

BIOLOGICAL EFFECTS OF ATOMIC RADIATION*

MAN is exposed to differing intensities of radiation from natural sources like cosmic rays and the radio-active elements present in rocks and soils in the different parts of the world. About 1,00,000 individuals in our own country are living in the monazitic sandy areas of Kerala which show exceptionally high radiation intensities owing to their high content of thorium. The buildings in such areas offer little shielding effect because they are constructed of materials available locally. Often,

the dose received is greater inside the buildings. The radiation from natural sources is negligible when compared to those from man-made sources. Yet, they have a cumulative effect and are suspected to be the agencies responsible for spontaneous mutations in the germ track; those small heritable changes, often deleterious in effect, finding expression in the future generations.

The risks inherent in the diagnostic and therapeutic application of X-rays pale into insignificance when compared to those of use and tests of atomic weapons. The atomic bombs dropped on Hiroshima and Nagasaki killed thousands of people. The survivors did not escape

* Report of the United Nations Scientific Committee on the "Effects of Atomic Radiation". General Assembly. Official Records: Thirteenth Session, Supplement No. 17, (A/3838), New York, 1958.

unscathed because of the latent effects of exposure to high radiation. The Marshall Islanders and the crew of a Japanese fishing vessel were accidentally exposed to high radiation from the fall-out after a nuclear explosion test.

What is more important is the general contamination of the atmosphere with radio-active materials from the stratospheric fall-out. Some of these like strontium-90 and caesium-137 are potentially hazardous because of their fairly long physical half life, their efficient transfer through food, high absorption by the body and the long retention in the system. Serious consideration has been given to strontium-90 in this context because of its selective incorporation in the bone structure and thus the localized irradiation of osteocyte and marrow cells.

The environmental contamination affects whole populations and the effects may be reflected not only in the present but in future generations also. The report of the Scientific Committee of the United Nations is an objective and exhaustive appraisal of these problems.

The most serious limitation in estimating the hazards to human beings appears to be the absence of any accurate information on the basic mechanisms producing the damage. "While the physical events are more or less understood on the basis of our knowledge of modern physics or physical chemistry, the unknowns on the biological side are still enormous. The need for fundamental research is therefore very great. The only way of meeting this challenge is by the training of scientists in the different disciplines that biological research demands" (p. 21).

There is a wide variation in the radio-sensitivity of different species of animals. Even the various tissues of an organism vary widely in this regard owing to regeneration phenomena and neuro-humoral regulations. The application of the conclusions drawn from animal experiments to Man, can therefore be only speculative in character.

When the whole body has been exposed to a lethal dose as a result of the explosion of a bomb or an accident in the laboratory, death supervenes in 50% of the people within sixty days. An hour or two after exposure there is nausea, vomiting and sometimes diarrhoea. These subside but during the subsequent period of subjective well-being, the blood cells decrease

to very low levels causing progressive anaemia with a tendency to bleeding.

The radiation syndrome is fully developed by the second or third week. There is high fever, loss of weight, extreme exhaustion, loss of hair, ulceration of the mouth and the alimentary tract and haemorrhages in the skin. The affected individuals become susceptible to infections from the normally harmless bacteria present in the body and usually die as a consequence.

If they survive, the recovery is rather slow because radiation not only damages tissues but also inhibits the process of repair and regeneration. With lower and lower doses, the symptoms become less and less acute and can often be detected with difficulty only from the blood picture. Recovery after a median lethal dose does not ensure later well-being. Delayed effects like leukemia, leucopenia, cataracts, loss of hair, change in texture and pigmentation of the skin and impaired formation of germ cells become apparent after a latent period extending to several years.

Repeated exposure to small doses of radiation during experiments, medical or diagnostic procedures, or from the general environment may have a cumulative effect in producing tumours, since the question whether a minimum or threshold dose is necessary for tumour induction remains still unsettled. The difficulty in evaluation is a consequence of the long induction period, which is ten to twenty years for some types of cancer and five to ten years for leukaemia, after a single irradiation.

What is more important is that environmental contamination and the consequent continuous exposure of the population to small doses of radio-activity may be reflected in the increased number of mutations determining hereditary disorders, general fertility, intelligence and even the life span of the individual in the succeeding generations.

"While some hazards are implicit in almost all technological advances, it must be remembered that inherited changes are an inescapable consequence of the irradiation of human populations, and that they affect at random persons who can seldom, if ever, be individually identified. They therefore pose ethical and legal problems which should be of special concern to Governments" (p. 30).

NATIONAL METALLURGICAL LABORATORY, JAMSHEDPUR: SYMPOSIUM ON "IRON AND STEEL INDUSTRY IN INDIA"

THE symposium organised by the N.M.L. was held from 4th to 7th February 1959 (see *Curr. Sci.*, 1958, 27, 466). The object of the symposium was to focus attention on the latest technological and research developments in the iron and steel industry and their rational utilisations. 37 papers, of which no less than 22 were contributions from outside India, covering the various aspects of iron and steel technology were presented and discussed.

The symposium drew a large gathering of top ranking scientists in different branches of iron and steel from all over the world. Among those who actively participated in it were Prof. Charles Crussard (France), Dr. P. Coheur (Belgium), Dr. T. P. Colclough, Mr. R. H. Colcutt and Mr. W. S. Hindson (U.K.), Prof. G. R. Bashforth (UNESCO), Prof. Erich E. Hofmann and Dr. Carl Popp (Germany), Dr. S. Maekawa and Prof. M. Y. Imai (Japan), and Mr. A. A. Parish (Australia).

The symposium was inaugurated by Prof. M. S. Thacker, Director-General, Scientific and Industrial Research and presided over by Sir J. J. Ghandy, Director-in-charge, Tata Industries Ltd. Dr. B. R. Nijhawan, Director, N.M.L. welcomed the delegates.

The high-light of the programme was the inauguration of the Low-Shaft Furnance Pilot-plant on the 5th February by Hon'ble Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel. In his inaugural address the Hon'ble Minister stressed on the importance of the plant for investigations on pilot-plant scale the production of pig-iron, utilising Indian iron ores and non-metallurgical fuels abundantly available in India. He congratulated Dr. Nijhawan and the research workers for the valuable work that is being done in the N.M.L.

The Low-Shaft Furnance Pilot-plant and auxiliaries were supplied by the Demag-Humboldt Niederschachtoven, Duisburg, West Germany. The Plant has a production capacity of 15 tons of pig-iron per day and will be able to treat different inferior grades of raw materials. The results of investigations to be conducted in this pilot-plant project will help in the establishment of small units for iron and steel production in different parts of the country.

The National Metallurgical Laboratory has issued the first number of its Quarterly Technical Journal which will be its official organ. This inaugural issue has been exclusively devoted for the symposium and contains nine full papers presented besides the abstracts of all the papers.

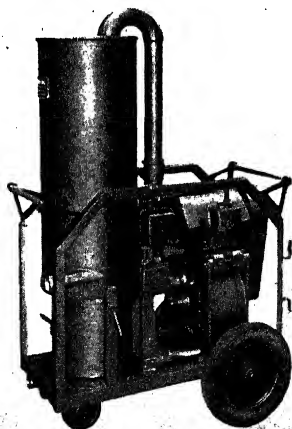
A NEW INDUSTRIAL VACUUM CLEANER

BIVAC AIR COMPANY, LIMITED of Stockport, England, who have specialized for the past 21 years in the production of industrial vacuum cleaning equipment have recently

announced the introduction of a new, vastly superior, industrial cleaner utilizing the well-proved 'Clear-Flo' air filter design which is non-clogging in operation and requires no shaker gear. This new model is known as the 'CL' and, in the standard version, is powered by a 5 H.P. electric motor. Other motor sizes, or a petrol engine, can readily be fitted if required.

An entirely new exhaustor has been developed for this machine which, though more compact than its predecessors, has greater suction power and is consequently even more efficient.

The 'CL' cleaner has been specifically designed for continuous heavy duty operation where serious vacuum cleaning must be carried out. Wherever large quantities of dust accumulate, or toxic powders have to be handled, the Bivac 'Clear-Flo' filter incorporated in the cleaner is a vital requirement. It prevents these harmful substances from recirculating in an airborne state through the workrooms,



UNDERGROUND WATERS ARE SOURCE OF HEAT ENERGY

F. A. MAKARENKO

UNDERGROUND waters are a cheap source of heat. The waters at such depths of the Earth's crust, that are quite accessible for present-day boring techniques, get considerably heated and form major artesian basins and fissure systems with great reserves that are continuously replenished by natural means. This kind of heat energy of the Earth's entrails is practically inexhaustible: many natural thermal springs function uninterruptedly throughout a geological period.

Heat from underground waters has been used by man since the most ancient times. Excavations of Neolithic, and probably of Paleolithic, man have been found near now-functioning thermæ. Ancient baths, cave settlements, remains of the culture of the bronze and early iron age have been found in the area of Mineral Waters in the Caucasus and in Armenia.

However, there were quite few natural outlets of thermal springs and very rarely were they situated in places that were convenient for settlements. Most frequently they were used for medicinal purposes. It is only with the development of scientific knowledge of underground and thermal waters, with the introduction of deep-hole boring, mainly in the last two decades, that the problem of large-scale economic utilization of the heat of underground waters started to attract universal attention.

Thermal underground waters which even recently were considered to be "specific" and "rare", beginning at certain depths and increasing in temperature as they become deeper, may be considered as continuous zones of underground waters. On the other hand, underground "cold" waters which are considered to be the usual thing are characteristic of a comparatively small top zone that forms only a thin covering film, if compared with the many-kilometre-deep layer of hot and superheated waters of the entrails of the Earth!

Being under pressure and having thermal capacity higher than the surrounding rock, the underground water accumulates heat generated underground and by force of its own dynamic energy conveys it in great quantities up to the surface. The excess pressure of drilling waters, which attains tens of atmospheres, ensures the

transfer of heat to the sites of consumption on the surface and creates considerable hydraulic energy.

In recent years thermal springs are finding ever greater application for heating and power production purposes. High temperature underground waters and vapours are utilized for producing electric energy, for central heating of towns, for warm water-supply, in agriculture for heating hotframes and hothouses, in public baths, bathing pools, and in shower installations. They have also found extensive application for medicinal purposes. These, however, are but the first steps in their versatile application.

In the Soviet Union underground water heat is mostly employed at the site, at the thermal spring outlets—in the various spas (Kuldur, Goryachevodsk, Braguny, Chukotka territory, Kamchatka, Magadan region, the Kuril Islands, Hoji-Obigarm, Transcaucasia) and in many oil-field districts.

Lately the work conducted by Soviet geologists, hydrogeologists, and geophysicists, has resulted in vast basins of bedded and fissure waters being found in the Caucasus, Transcaucasia, Central Asia, in the European part of the USSR, in various areas of Siberia and in Kamchatka. It is reported that there are hot bedded and fissure waters in the permafrost areas in the North and North-East of the Soviet Union under the strata of frozen rock: major thermal springs break through the layer of frozen rock there and appear at the surface with a temperature of up to 90-100° C. and with an immense yield (Chukotka territory, Okhotsk Sea coast, some areas of the Northern Urals, etc.). Many hot artesian water basins cover territories of tens and hundreds of hectares, while some of them, as for example the West Siberian artesian thermal water basin, cover a territory of millions of square kilometers.

The exceptional abundance of thermal waters in the USSR has been convincingly shown in a number of papers read at the first USSR Geothermal Conference held in 1956.

In the Caucasus which is better investigated in geothermal respect than other territories of the USSR a number of foothill and inter-hill underground water basins have been discovered, that possess great pressures, valuable chemical

composition, and considerable water yields in the boreholes, the water temperature in the geosyncline flexures of many aquifers being 100-150° C. and up to 270° C. and over. Their resources are practically unlimited. Many hot waters possess an excess pressure of tens of atmospheres under the hole mouth, contain valuable salts and rare elements (iodine, bromine, boron, sulphur, etc.) in industrial quantities. The boreholes usually have quite a large yield—up to 50 litres per second and sometimes even as high as 100 litres per second and over.

Not so long ago the existence of hot waters on the territory of the European part of the USSR had not even been suspected. But this area turned out to be a territory of thermal and high-thermal water development at considerable depths—1,500 m and deeper (Second Baku District, Dniepropetrovsk—Donets syncline, North Caspian area, Moscow syncline, and others).

At a number of extremely large artesian basins in Turkmenia (Kopet-Dag flexure, West Turkmenia's basins, etc.), in the Uzbek SSR (Tashkent, North-Tashkent, Ferghana basins, etc.), in the Tajik SSR, in the foothills of the Tyan-Shan mountains within the boundaries of Kirghiz SSR the deep underground waters with zonal variations of mineralization and chemical composition are characterized by still higher temperatures.

Thermal springs are no less developed in the central and eastern parts of Siberia, within the Chukotka territory, and in the areas of the Pacific coasts of the USSR. There are hundreds of natural outlets in the Transbaikalian region alone, characterized by very high temperatures and great yields, making it possible to provide a multitude of towns and villages with central heating and to set up local health resorts, as well as, major hothouse and hotframe vegetable establishments.

Well-known are the countless thermal springs, geysers, and hot vapour and gas fumaroles in the present-day volcanic areas of the Kamchatka and Kurile volcanic islands arc. The heat from the depths of these areas may

be used for creating major geothermal power plants, while many of the natural thermal springs on Kamchatka and the Kurile islands may serve as bases for large-scale hothouse vegetable and fruit growing establishments that are so important for the population of the Far East.

Thus, the hydrothermal resources of the Soviet Union are practically boundless. They may be brought on to the surface by boring to greater or smaller depths in many regions of the country.

The Laboratory of Hydrogeological Problems of the USSR Academy of Sciences together with other institutions has recently compiled the first general summary of the prospected sources of underground water and vapour heat in the USSR, to be utilized for heating and power production purposes. This summary recommends that over 60 towns be supplied with central heating and suggests more than 100 districts where hot underground waters should be regionally used for agriculture, residential house heating, communal, technical, and sanitary-hygienic purposes.

Preliminary calculations show that for organizing the central heating of a town with 100 thousand inhabitants it is sufficient to utilize two or three high-yield holes with hot water, which, according to the data furnished by the Daghestan Branch of the USSR Academy of Sciences, will give a saving of no less than 10 million rubles.

The utilisation of the heat of underground waters for commercial purposes will not only provide a great saving but this energy of the Earth will save the national economy millions of tons of wood fuel, coal, and oil and will considerably relieve pressure on transport.

Many medicinal and oil-bearing thermal springs in the Caucasus bring to the surface great quantities of sulphur, boracic acid, bromine, iodine, carbon dioxide, helium, lithium, and other elements. The yield in drilled and natural thermal springs of some scarce salts and elements comes to tens, hundreds, and even thousands of tons a year.

LETTERS TO THE EDITOR

A SHORT NOTE ON
SELF-RECIPROCAL FUNCTIONS

1. FOLLOWING the notation of Hardy and Titchmarsh,³ we denote a function $f(x)$ as R_μ , if it is Self-Reciprocal for Hankel Transforms of order μ , so that it is given by

$$f(x) = \int_0^\infty J_\mu(xy) f(y) \sqrt{xy} dy, \quad (1.1)$$

where $J_\mu(x)$ is a Bessel function of order μ . If, however, $f(x)$ is replaced by $-f(x)$ on the left-hand side of (1.1), then $f(x)$ is said to be Skew Reciprocal for Hankel Transforms of order μ and is denoted by $-R_\mu$. In this note we find a Self-Reciprocal function, particular cases of which reduce to functions already obtained.

2. Theorem:

If $f(x)$ is $\pm R_\mu$,

$$\text{then} \quad \phi(x) = F^n(a) f\{xF^{2n}(a)\} \pm \frac{1}{F^n(a)} f\left\{\frac{x}{F^{2n}(a)}\right\}, \quad (2.1)$$

is $\pm R_\mu$, where $F(a) \neq 0$,

Proof:

$$\begin{aligned} \int_0^\infty J_\mu(xy) \phi(y) \sqrt{xy} dy &= \int_0^\infty J_\mu(xy) \left[F^n(a) f\{yF^{2n}(a)\} \pm \frac{1}{F^n(a)} f\left(\frac{y}{F^{2n}(a)}\right) \right] \sqrt{xy} dy, \\ &= \int_0^\infty J_\mu(xy) F^n(a) f[yF^{2n}(a)] \sqrt{xy} dy \\ &\quad \pm \int_0^\infty J_\mu(xy) \frac{1}{F^n(a)} f\left[\frac{y}{F^{2n}(a)}\right] \sqrt{xy} dy. \end{aligned} \quad (2.2)$$

Putting $yF^{2n}(a) = u$ in the first integral of the right-hand side, we find that it becomes

$$\frac{1}{F^n(a)} \int_0^\infty J_\mu \left[\frac{xu}{F^{2n}(a)} \right] f(u) \sqrt{\frac{xu}{F^{2n}(a)}} du,$$

$$\text{which is} = \frac{1}{F^n(a)} f\left\{\frac{x}{F^{2n}(a)}\right\}$$

since $f(x)$ is R_μ .

(2.3)

Similarly putting $\frac{y}{F^{2n}(a)} = u$ in the second

integral of the same side, we find that it becomes

$$F^n(a) \int_0^\infty J_\mu [xuF^{2n}(a)] f(u) \sqrt{xuF^{2n}(a)} du, \quad (2.4)$$

which is $= F^n(a) f\{xF^{2n}(a)\}$.

Hence we find that

$$\int_0^\infty J_\mu(xy) \phi(y) \sqrt{xy} dy = \pm \phi(x), \quad (2.5)$$

according as $f(x)$ is $\pm R_\mu$ where

$$\phi(y) = F^n(a) f\{yF^{2n}(a)\} \pm \frac{1}{F^n(a)} f\left\{\frac{y}{F^{2n}(a)}\right\}.$$

Putting $n=1$, we find that

$$\phi(y) = F(a) f\{yF^2(a)\} \pm \frac{1}{F(a)} f\left\{\frac{y}{F^2(a)}\right\}. \quad (2.6)$$

which has been shown to be R_μ , by Dr. Brij Mohan.¹

Again putting $F^n(a) = a^n$, we find that the function

$$\phi(y) = a^n f(ya^{2n}) \pm \frac{1}{a^n} f\left(\frac{y}{a^{2n}}\right), \quad (2.7)$$

which is also due to Dr. Brij Mohan.²

3. Examples:

The author has shown in previous paper⁴ that the function

$$\frac{J_\mu(a_1x) J_\nu(a_2x) \dots J_k(a_nx)}{x^{\mu+\nu+\dots+k+\frac{1}{2}}}, \quad (3.1)$$

where $a_1 + a_2 + \dots + a_n$ is finite and a_1, a_2, \dots, a_n are all +ve, is R_1 .

Hence from (2.1), it follows that

$$\begin{aligned} &\frac{F^n(a) J_\mu [a_1 x F^{2n}(a)] J_\nu [a_2 x F^{2n}(a)] \dots J_k [a_n x F^{2n}(a)]}{[F^{2n}(a) x]^{\mu+\nu+\dots+k+\frac{1}{2}}} \\ &\pm \frac{1}{F^n(a)} \frac{J_\mu \left[\frac{a_1 x}{F^{2n}(a)} \right] J_\nu \left[\frac{a_2 x}{F^{2n}(a)} \right] \dots J_k \left[\frac{a_n x}{F^{2n}(a)} \right]}{\left[\frac{x}{F^{2n}(a)} \right]^{\mu+\nu+\dots+k+\frac{1}{2}}}, \end{aligned} \quad (3.2)$$

where $a_1, a_2 \dots a_n$ are all +ve and finite, and $F(a) \neq 0$, is R_1 .

Again, as has been shown in another paper⁵ that the function

$$\left[J_1 \left(\frac{x}{\sqrt{2}} \right) \right]^2, \quad (3.3)$$

is $R_{5/2}$.

Hence it follows from (2.1), that

$$F^n(a) J_1^2 \left[\frac{x F^{2n}(a)}{\sqrt{2}} \right] \pm \frac{1}{F^n(a)} J_1^2 \left[\frac{x}{F^{2n}(a) \sqrt{2}} \right], \quad (3.4)$$

where $F(a) \neq 0$, is $R_{5/2}$.

My thanks are due to Dr. Brij Mohan for his help and guidance in the preparation of this note.

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THE ANOMALOUS NUCLEAR SCATTERING OF HIGH ENERGY MUONS

THE multiple nuclear scattering of cosmic radiation muons of energies between 600 Mev and 100 Gev turns out to be anomalously consistent with the nuclear electrostatic scattering by a point nucleus as observed and summarised by Lloyd, Rössle and Wolfendale.¹ Further, the observed scattering varies as Z^2 or A^2 indicating that it is largely elastic. At the same time the observed nuclear star production cross-section is very small as determined by George and Evans.²

The purpose of the present investigation is to consider the possible nuclear optical model for such anomalous nuclear scattering of high energy muons. The muon spin is disregarded as its effects cancel out in the proposed comparison. It is reasonable to assume the approximate validity of the first Born approximation for such a preliminary consideration.

Assuming spherical symmetry, the scattering amplitude in this approximation is given by

$$f(s) = -\frac{1}{s} \int_0^\infty U(r) \sin(sr) r dr, \quad (1)$$

where $s = 2k \sin(\theta/2)$ while $U(r) = 2E V(r)/$

$(\hbar c)^2$ with $V(r)$ the complete nuclear potential. One can now write

$$U(r) = -2kn\rho(r) + V_e(r), \quad (2)$$

where $n = n_1 + in_2$ is the nuclear complex refractive index parameter, $\rho(r)$ is the nuclear density and $V_e(r)$ represents the nuclear electrostatic potential.

Assuming a uniform nuclear density distribution of radius R , one obtains, with $a = Ze^2/\hbar c$, the elastic scattering cross-section as

$$\sigma(s)_s = \frac{9k^2}{s^4} \left[\left\{ \frac{2a}{(sR)^2} + \frac{n_1 A}{2\pi R^2} \right\}^2 + \left\{ \frac{n_2 A}{2\pi R^2} \right\}^2 \right] \left[\frac{\sin(sR)}{(sR)} - \cos(sR) \right]^2 \quad (3)$$

The large fluctuations in $\sigma(s)$ produced by the last factor of equation (3) will be disregarded in the present approximate consideration, since exact calculations by Yennie *et al.*³ show that they are considerably smaller than those given by equation (3). As the electrostatic scattering for such an extended nucleus is negligible as compared to the anomalous scattering for large values of s , one can write for such values of s

$$\sigma(s) \simeq \frac{9k^2 A^2 |n|^2}{4\pi^2 (sR)^4}. \quad (4)$$

But for such large s , the experimental observations agree anomalously with the nuclear electrostatic scattering by a point nucleus, given by

$$\sigma(s) = \frac{4k^2 a^2}{s^4}. \quad (5)$$

Thus one obtains $|n| = 4\pi a R^2 / 3A$ by comparing equations (4) and (5).

Taking $R = 1.1 A^{1/3} f$, one obtains $|n| \simeq 5 mb$ for lead and $|n| \simeq 3 mb$ for iron. Of course $|n|$ must be the same for each nucleus and may be taken to be about 4 mb on the average. The absorption cross-section σ_a to the first order in refractive index is given by $\sigma_a = 2n_2 A$ as shown by Gatha and Shah.⁴ Substituting the observed values of σ_a one gets $n_2 \simeq 0.005 mb$ and hence $n_1 \simeq 4 mb$.

It is now possible to get some information about muon-nucleon interaction from the values of n_1 and n_2 . One has, in the impulse approximation $n = 2\pi f(o)/k$ where $f(o) = f_1(o) + if_2(o)$ is the complex forward scattering amplitude for scattering by free nucleons. One can now use the optical theorem giving the total scattering cross-section $\sigma_t = 4\pi f_2(o)/k$, which leads to $\sigma_t = 2n_2 \simeq 0.01 mb$.

One may regard this σ_t to be largely due to inelastic processes like pion production. But as $n_1 \gg n_2$ one has $f_1(o) \gg f_2(o)$ which is rather unlikely for such processes. Also such pions have not been observed. On the other

hand an anomalous real potential between muon and nucleon can give the necessary large value for $f_1(o)$ and small value for $f_2(o)$ since only $f_1(o)$ would be given by the first Born approximation while $f_2(o)$ would be given only by the higher Born approximations. Hence one may regard the muon-nucleon scattering as largely elastic and try to find out the approximate range of such a potential.

For such a real potential the elastic scattering cross-section $\sigma_e = \sigma_t$ is given by

$$\sigma_e = \frac{2\pi}{k^2} \int_0^{2k} |f(s)|^2 s ds \simeq 0.01 \text{ mb.} \quad (6)$$

For a rough estimate of the range of s , $|f(s)|^2$ may be assumed to be a step function given by $|f(s)|^2 = |f(o)|^2 \simeq |f_1(o)|^2$ upto $s = S$ and $|f(s)|^2 = 0$ for $s > S$. Substituting in equation (6) one obtains $S \simeq 3 \times 10^{12} \text{ cm}^{-1}$. The range of the corresponding potential, in the first Born approximation may be approximately given by $1/S \simeq 3f$. The approximate order of magnitude of the mass of the exchanged quantum, giving rise to such an anomalous potential, would then be about a hundred electron masses. Such an exchange interaction between muon and nucleon is therefore expected to give agreement with the observed anomalous nuclear scattering of high energy muons, while it will be negligible in comparison with the electrostatic interaction at lower energies. These investigations are now in progress.

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STUDY OF ULTRASONIC VELOCITY IN ORGANIC SOLUTIONS

WHILE investigating ultrasonic velocities in solutions of organic substances like naphthalene, etc., in organic solvents, Schaaffs¹ and others² have shown that, in general, the ultrasonic velocity increases linearly with concentration. Subsequently Lal and Sharma³ have reported a consistent decrease of ultrasonic velocity with increase of concentration for the solution of benzoic acid in several alcohols. It was also shown that the molar sound velocity R of the solution increases linearly with molar fraction and that the extrapolated value for 100% concentration is a characteristic constant for the pure solid. In a recent communication Lal⁴ has utilised Rao's equation to calculate the ultrasonic velocity in the pure solid solute existing in a hypothetical liquid state and the value thus obtained for benzoic acid was reported as 3,920 m./sec.

The authors have systematically investigated the ultrasonic velocities in solutions of benzoic acid in chloroform, benzene and ethyl alcohol using the variable frequency fixed path interferometer⁵ and the results are presented in Table I.

It will be seen from the results presented in Table I that the velocity increases with concentration for all the solvents studied in a more or less linear manner, a result which is contrary to the conclusions of Lal and Sharma.³ But as reported by them, the values of R are found to increase linearly with molar fraction, but the average of the extrapolated values for 100% concentration obtained by us is 1174 as against the average value of 1527 reported by them. It is to be noted that the present value of R compares favourably with the calculated value of 1213 obtained by Rao's method of atomic increments and the value of 1199 obtained by Lagemann method of bond increments.

TABLE I
Room Temperature 30° C.

Benzoic acid chloroform	..	Cm. %	0	2.595	5.051	7.401	9.618	100 (extrapolated)
		V m./s.	985	991	998	1012	1027	1620
		R	807.6	816.0	823.5	831.6	841.0	1151
Benzoic acid Benzene	..	Cm. %	0	2.288	4.660	6.829	..	100 (extrapolated)
		V m./s.	1294	1297	1304	1312	..	1632
		R	975.2	978.8	984.5	991.7	..	1216
Benzoic acid-ethyl alcohol	..	Cm. %	0	1.540	3.031	4.479	..	100 (extrapolated)
		V m./s.	1140	1151	1160	1168	..	1718
		R	587.3	606.1	614.6	622.6	..	1154

As the variation of ultrasonic velocity with concentration is almost linear, in the limited concentration range possible, the velocity for 100% concentration is obtained by extrapolation and the values thus obtained for the three solvents are fairly consistent. This velocity does not correspond to the velocity of the solute in the solid state but it corresponds to the characteristic velocity for the hypothetical case of the solute existing in the liquid state at the room temperature. This value cannot therefore be checked by a direct determination. However, it is interesting to note that this average value 1657 m./sec. is in reasonable agreement (considering the wide range of extrapolation) with the value of 1506 m./sec. obtained from Rao's formula using the known value of R for the solute and assuming a density⁶ value of 1.166 gm./c.c.

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SYNTHESIS OF 5'-BENZOYL-3'-CHLORO-2'-HYDROXYCHALKONES

ALTHOUGH a considerable amount of work has appeared describing the synthesis of the chalkones containing hydroxy and alkoxy groups in the phenyl and styryl components, those containing other substituents have been comparatively less studied. Some chalkones containing halo,¹ acetamino,² carboxyl³ and nitro⁴ groups have been reported in the literature, and recently the chalkones containing the benzoyl⁵ groups have been reported from this laboratory.

In continuation of such work 5-benzoyl-3-chloro-2-hydroxyacetophenone prepared by the Fries migration of 2-chloro-4-benzoylphenyl acetate (under publication) has been condensed with various aldehydes.

All the chalkones gave characteristic deep red colour with concentrated sulphuric acid and brownish red colour with alcoholic ferric chlo-

ride. Most of them were sparingly soluble in sodium hydroxide giving yellow colour.

The chalkones obtained with various aldehydes are listed in Table I.

TABLE I

Benzaldehyde	M.P. of the chalkone °C.	Formula of the chalkone	Chlorine percentage required	Found
1. Benzaldehyde ..	142	$C_{22}H_{15}O_3Cl$	9.79	9.51
2. 2-Hydroxy ..	199	$C_{22}H_{15}O_4Cl$	9.38	9.07
3. 3-Hydroxy ..	160	$C_{22}H_{15}O_4Cl$	9.38	9.11
4. 4-Hydroxy ..	220	$C_{22}H_{15}O_4Cl$	9.78	9.02
5. 4-Methoxy ..	161	$C_{23}H_{17}O_4Cl$	9.05	8.87
6. 3-Methoxy-4-hydroxy ..	167	$C_{23}H_{17}O_5Cl$	8.69	8.32
7. 3:4 Methylene dioxy ..	195	$C_{23}H_{15}O_5Cl$	8.73	8.46
8. 3-Nitro ..	155	$C_{22}H_{14}O_5NCl$	8.71	8.48
9. 3-Chloro-4-Methoxy ..	195	$C_{23}H_{16}O_4Cl_2$	16.63	16.38

Of the above chalkones, 5'-benzoyl-3'-chloro-2'-hydroxychalkone (No. 1) was cyclised to the corresponding flavanone, m.p. 131° (Found: Cl, 9.54, $C_{22}H_{15}O_3Cl$ required Cl, 9.79 per cent.) by alcoholic sulphuric acid.⁶ It was also oxidised to 6-benzoyl-8-chloroflavone m.p. 197-98°, (Found: Cl, 9.61, $C_{22}H_{13}O_3Cl$ required Cl, 9.85 per cent.) and 6-benzoyl-8-chloroflavonol m.p. 265° (Found: Cl, 9.14, $C_{22}H_{13}O_4Cl$ required Cl, 9.43 per cent.) by selenium-dioxide in amyl-alcohol⁷ and alkaline hydrogen peroxide⁸ respectively.

Further work is in progress.

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INFRARED AND RAMAN INTENSITIES OF ALIPHATIC DERIVATIVES

BELLAMY¹ and Rao and Silverman² first pointed out that the infrared group frequencies in aliphatic compounds can be correlated by the Taft aliphatic polar substituent constants, σ^* , of groups.³ The infrared band intensities of aliphatic derivatives have also been shown to depend on the polar contributions of groups.⁴ We have now tried to correlate the infrared and the Raman intensities of the hydroxy group and the carbonyl group in aliphatic alcohols and ketones respectively.

The infrared band intensities, A_{OH} , of the hydroxy group in aliphatic alcohols reported by Brown and Rogers⁵ and Flett⁶ were normalized by a scale factor and plotted against the σ^* constants (cf. Fig. 1). An approximately linear relation with a positive slope is observed. The hydroxy frequencies show a linear relation with σ^* with a negative slope.

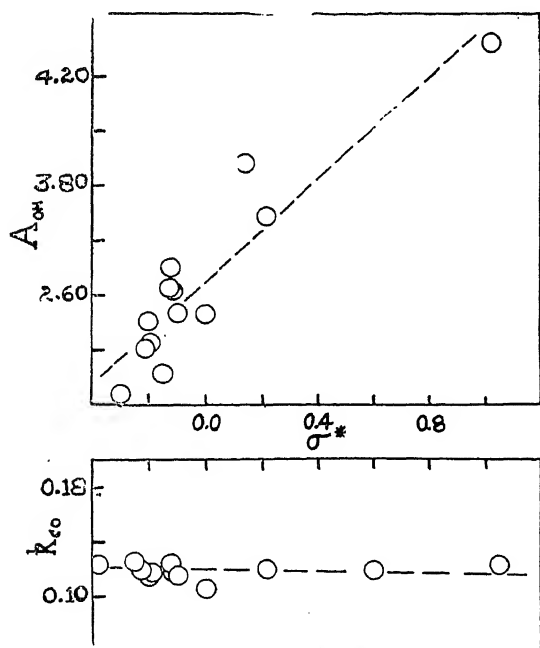


FIG. 1. Plots of the infrared intensities of the aliphatic alcohols and the Raman intensities of aliphatic ketones against the Taft σ^* parameters.

In Fig. 1 the Raman intensities of the carbonyl group in aliphatic ketones⁷ are plotted against the σ^* constants. The Raman intensities have been expressed in terms of the scattering coefficients, k . The carbonyl group intensity seems to be rather insensitive to structural

variations. A similar observation has been made earlier with regard to the infrared carbonyl intensities in aromatic derivatives.³ However, the carbonyl band intensity in aliphatic amides has been found to vary considerably with structural environment⁴ and to show a linear relation with σ^* with a negative slope. The carbonyl frequencies in aliphatic ketones give a ν - σ^* linear plot with a positive slope.⁹

It appears fairly general that the group frequencies and intensities in aliphatic derivatives can be correlated by the Taft σ^* parameters. The slopes of the linear relations of the frequencies and the intensities in both aliphatic and benzene derivatives⁸ bear opposite signs.

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A NOTE ON THE STUDY OF HAEMOGLOBINS BY PAPER ELECTRO- PHORESIS

SINCE it has been reported by Pauling *et al.*¹ that sickle cell anaemia is a molecular disease and the electrophoretic mobilities of normal and sickle cell haemoglobins are different, electrophoresis has become more or less a standard procedure for the differentiation of some haemoglobin variants. Though less sensitive than the moving boundary method, filter-paper electrophoresis has subsequently been applied quite widely for this purpose because of the simplicity of the apparatus and the ease of manipulation. Sickle-cell trait among the population in some tribal areas in India has been reported by various workers and the most recent survey pertaining to some tribes in western India is that of Sukumaran *et al.*² An attempt has been made here to examine by this technique the

haemoglobin of an adult woman patient provisionally diagnosed as a case of sickle cell anaemia; foetal blood haemoglobin and haemoglobin of normal individuals have also been examined simultaneously. Some of the observations are reported below.

The method of haemoglobin preparation and the electrophoresis apparatus used were similar to those described by Smith and Conley.³ Veronal buffer of pH 8.6 and 0.05 molar strength was used. The voltage applied was 280 and the current passing was of the order of 10 milliamperes. Using comparable concentrations, lying between 2 to 5 per cent., the one from the patient was shown to be slower than the normal variant (Fig. 1). This differ-

globin, and it tended to retard the migration of the latter in an admixture. To render this technique more reliable as a means of identification it would be desirable to place identically treated controls of known composition on the strip containing the unknown sample. Considering the various limitations, as pointed out by others⁴⁻⁶ as well, it is recognised that this technique as such may be considered as a useful adjunct to other physico-chemical and clinical methods of analysis.

The author is thankful to Dr. D. S. Kothari, Scientific Adviser to the Minister for Defence, for his kind interest in this work, and to Lt.-Col. S. K. Mazumdar, A.M.C., for helping to procure the samples.

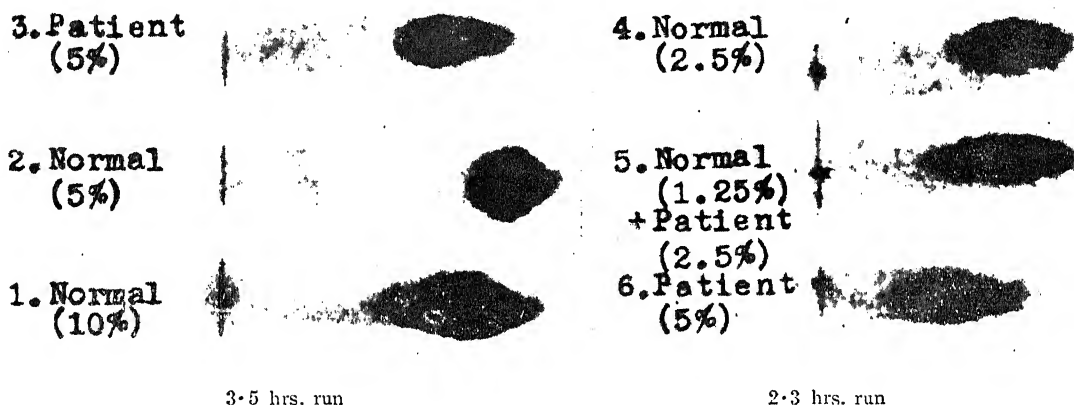


FIG. 1. Relative positions of haemoglobins from a normal subject and the anemic patient using different concentrations and time of run. Figures in parentheses refer to the approximate haemoglobin concentrations in the test solutions.

ence became quite distinct within two hours and a run over four hours was not considered necessary. Too long a run on the other hand, resulted in only diffused pattern with no further fractionation. Thus from the patterns obtained under the present experimental condition it was quite clear that the unknown sample was definitely different from the normal one. While an accurate measurement of electrophoretic mobility was not found feasible by this technique, a comparison of the present picture with that reported in the literature³ for different haemoglobins and microscopic examination of the red cells suggest the haemoglobin from the patient to be of the sickle cell type. While examining separately the haemoglobin of foetal blood, it was noticed that its relative migration was not much different from that of normal haemo-

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IDENTIFICATION OF CHOLIN- ESTERASE IN COBRA VENOM AFTER ELECTROPHORETIC SEPARATION ON STARCH GEL

VENOMS of *Colubridæ* species are characterized by the presence of cholinesterase while it is absent in venoms of *Viperidæ*.¹ Identification of enzymes after electrophoresis is usually carried out by adapting histochemical procedures.² Those so far in use for the localization of cholinesterase³⁻⁶ are dependent on the hydrolysis of suitable substrate and converting the products of reaction into dyes by suitable coupling agents. Recently, Kramer and Gamson⁷ have introduced indophenyl acetate as a substrate for direct colorimetric estimation of acetyl-cholinesterase activity and have worked out conditions for its quantitative determination. The present communication describes the application of indophenyl acetate as a chromogenic agent to locate the position of cholinesterase in electrophoretic strip or gel.

water in the ratio of 1:5:4, for one minute. The block was then washed repeatedly with 1% acetic acid.

The stained blocks can also be dried at room temperature in a current of air on a glass sheet and in that condition are more or less transparent and can be preserved.

The second starch block was covered with a thin layer of indophenyl acetate solution (0.1 c.c. stock solution containing 0.375 g. indophenyl acetate in 25 c.c. ethanol, is diluted to 2.5 c.c. with veronal buffer pH 8.0). Within about 5 minutes a dark blue band locating the position of cholinesterase could be seen against an orange background.

Figure 1 shows the starch electrophoresis blocks stained for protein (upper) and for cholinesterase (lower).

Venoms of cobra and krait showed the presence of cholinesterase while the venoms of Russell's viper and saw-scaled viper did not show its presence. The method described above is of

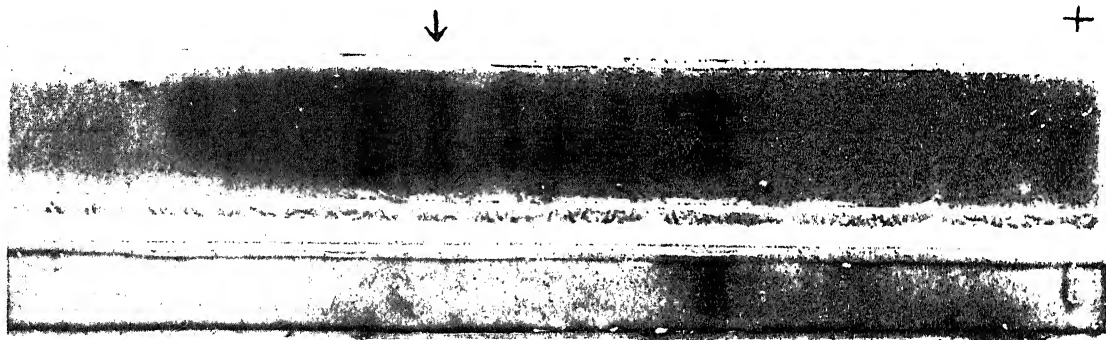


FIG. 1. Electrophoresis of cobra venom in starch gel. Upper strip : Stained for proteins with Amido black 10 B. Lower strip : Treated with indophenyl acetate for cholinesterase.

Electrophoresis of cobra venom was carried out on starch gel according to the method of Smithies⁸ using 10% potato starch gel prepared in tris-citrate buffer (pH 8.6, ionic strength 0.05) as recommended by Poulik.⁹ The electrode vessels contained borate buffer of same pH and ionic strength. Each of the starch blocks was 2.0 mm. thick, 25 cm. long and 2.5 cm. wide. Four such blocks cast over cellophane paper supported on glass sheet were subjected to electrophoresis for about 5 hours at 12 milliamperes.

After electrophoresis, one starch block was stained for proteins, using 0.5% amido black 10 B in a mixture of acetic acid: methanol:

general application for identification of cholinesterase from other sources also.

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SYNTHESIS OF 1-(4-VERATRYL) (N-7-AMINO-N-PROPYL) ALKYLAMINES

A NUMBER of diamines have been synthesised by various workers¹⁻⁵ in order to find a suitable substitute for emetine in amebiasis; but so far none of the compounds synthesised proved superior to emetine *in vivo*. The authors have however attempted the synthesis of 1-(4'-veratryl) (N-7-amino-n-propyl)-alkylamines with alkyl substituents as ethyl, n-propyl, n-butyl, n-amyl and n-hexyl with a view to test their antibacterial activity. Acyl veratroles were reduced to 1-(4'-veratryl)-alkylamines through the reduction by sodium and alcohol of the corresponding oximes. These monoamines were condensed with acrylonitrile to form the cyanoethyl products which on reduction with lithium aluminium hydride gave 1-(4'-veratryl) (N-7-amino-n-propyl)-alkylamines. These diamines are being tested for their pharmacological activity. The details of the synthesis will be published elsewhere.

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RHIZOSPHERE MICROFLORA OF PTERIDOPHYTES

MUCH work has been done on the rhizosphere microfloras of angiosperms.¹⁻⁶ Despite the fact that root systems of pteridophytes have been shown to harbour fungal root parasites of cultivated crop plants,⁷ as for instance, the isolation of *Corticium koleroga* (Cke) V.H. (which causes

the coffee root disease) from *Polypodium lineare* Thw. and *Cyclophorus* (Niphobolus) *aerostichoides* J. Sm.,⁷ and the isolation of plurivorous parasites like *Sclerotium rolfsii* Sacc., and *Corticium solani* Bourd. et Galz. from *Pteris longifolia* L. and *Pteridium equilinum* Kuhn no serious study of these plants has been undertaken so far.

Rhizosphere effect of pteridophytes, represented by members belonging to the Equisetaceae, Cyatheaceae and Polypodiaceae are presented here. Live specimens of *Equisetum* sp., *Lastrea* spp., *Pteris* spp. and *Cyathea* sp. were collected from high altitude plantation areas in the Nilgiri Hills and specimens of the garden varieties, *Pleopeltis* sp. and *Adiantum* sp., were collected at Madras. Methods followed for rhizosphere analysis are those detailed by Agni-hotrudu.⁶

Results indicate (Fig. 1) that factors known to influence a definite flora in the root region of

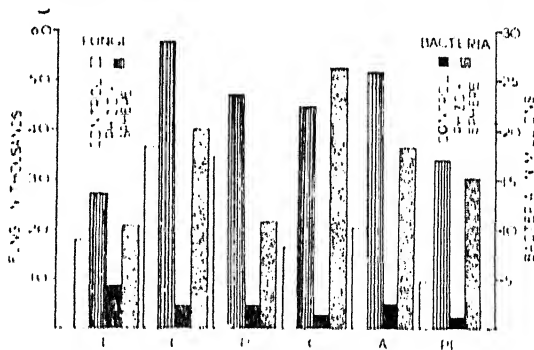


FIG. 1. Showing the rhizosphere microflora of pteridophytes. E - *Equisetum* sp.; L - *Lastrea* spp.; P - *Pteris* spp.; C - *Cyathea* sp.; A - *Adiantum* sp.; PL - *Pleopeltis* sp.

angiosperms appear to equally well apply to pteridophytes. It is generally agreed that stimulation of microfloras in the root region of many angiosperms is due to the nature and amount of root exudates and sloughed off root material.² From a perusal of the data obtained here, it seems appropriate to make out a similar case for pteridophytes.

Quantitatively, fungal and bacterial numbers in the rhizosphere of the four genera studied were in the order of *Lastrea* - *Adiantum* - *Pteris* - *Equisetum*. Qualitatively, the flora showed a significant increase in *Penicillium* spp. and *Aspergillus* spp., but the interesting feature of the investigation was the frequent isolation of *Trichoderma* spp., often overgrowing other species of fungi in culture. Pathogenic forms like *Fusarium* spp. were infrequently found in

soil dilutions as well as root plating but were not consistent.

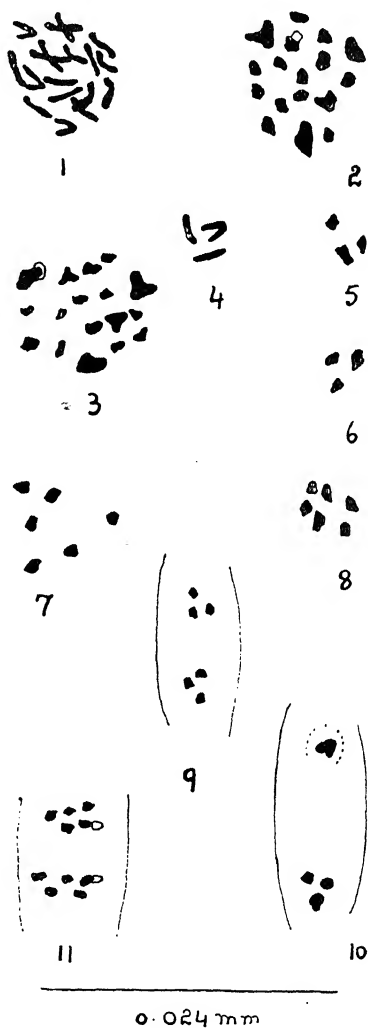
This study, therefore, opens out a new field for investigation to soil mycologists with pteridophytes in the temperate climate of our hill stations as well as in the subtropical soils in an attempt to correlate the occurrence of pathogenic fungal forms and incidentally problems of root exudates of this group of plants and their utilization by soil fungi.

I am deeply indebted to Prof. T. S. Sadasivan and Dr. C. V. Subramanian for advice and to the University of Madras, for the award of a studentship.

T. K. RAMACHANDRA REDDY.

University Bot. Lab.,
Madras-5,
October 17, 1958.

than the remaining 15 pairs (Figs. 2-3). Meiosis follows the normal course.



FIGS. 1-3. *Physcomitrium japonicum* (Hedw.) Mitt. Fig. 1. 18 chromosomes at metaphase in antheridial cells. Figs. 2-3. 18 bivalents at metaphase I.

FIGS. 4-11. *Physcomitrium* sp. Fig. 4. 3 chromosomes at metaphase in antheridial squash. Figs. 5-6. 3 bivalents in A type at metaphase I. Figs. 7-8. 6 bivalents at metaphase I in B type. Fig. 9. Anaphase I in A type. Fig. 10. Telophase I in A type. Fig. 11. Anaphase I in B type.

Physcomitrium sp.—In antheridial squashes three chromosomes were counted at metaphase. One of the chromosomes has middle while the remaining two show terminal attachment (Fig. 4).

In single capsule squash, the author, to his great surprise, observed two types of sporocytes

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CYTOLOGICAL STUDIES IN INDIAN MOSSES

V. *Physcomitrium japonicum* (Hedw.) Mitt. and *Physcomitrium* sp.

In earlier papers in this series Pandè and Chopra¹⁻⁴ reported the cytology of twenty-five mosses. Chopra⁵ worked out the chromosome number of some Bryaceae.

Physcomitrium japonicum (Hedw.) Mitt. was collected from Nainital during the month of August while *Physcomitrium* sp. has a restricted but a luxuriant growth in the compound of the historic Residency building during the months of July-September. The material for the present study was fixed in acetic-alcohol (1:3) and the observations are based on usual actocarmine squash method.

Physcomitrium japonicum (Hedw.) Mitt.—In antheridial squashes 18 chromosomes were counted at metaphase. Three chromosomes have middle attachment and are V-shaped while the remaining 15 show terminal attachment and are rod-like (Fig. 1). In several sporocytes 18 bivalents were counted at metaphase I. Three pairs are conspicuously larger

named as 'A' and 'B' showing a marked difference in size. In 'A' sporocytes three bivalents were regularly counted at metaphase I (Figs. 5-6) while in 'B' type 6 bivalents were counted at diakinesis (Fig. 7) and metaphase I (Fig. 8). In both types of sporocytes there is no morphological difference in the chromosome pairs.

Meiosis was followed in both types of sporocytes. Three and six chromosomes were counted at both anaphase I and telophase I in A and B respectively (Figs. 9-11). Meiosis follows the normal course in both types of sporocytes.

The origin of polyploid sporocytes can reasonably be attributed to the premeiotic disturbance in the archesporial cells in the early stage of capsule development. The premeiotic disturbance might have been caused by the sudden change in temperature which resulted in the breakage of the spindle.

As far as the author is aware $n=3$ is the smallest chromosome count ever reported in mosses.

Table I shows the chromosome counts in genus *Physcomitrium*. Evidently there is a high degree of polyploidy in *Physcomitrium pyriforme*,

TABLE I

Name of the plant	n	Author
Genus <i>Physcomitrium</i>		
<i>P. pyriforme</i>	18	Schmidt ⁶
do.	9	Pandè and Chopra ¹
do.	27	Bryun ⁷
<i>P. eurystomium</i>	9	Sannomiya ⁸
<i>P. japonicum</i>	18	Chopra (present study)
<i>P. sp.</i>	3 and 6	do.

the basic number being nine with tetraploid and hexaploid races. It is possible that the basic number for the genus *Physcomitrium* is 3 and the other species are the polyploids, originated in the speciation of the genus from the parent stock with $n=3$ or species with $n=3$, $n=9$, $n=18$ have a parallel evolution in the origin of species of the genus *Physcomitrium*.

The author is extremely thankful to Dr. S. K. Pandè, D.Sc., of Lucknow University, under whose guidance this study was taken up and to Prof. S. N. Das Gupta for facilities and encouragement.

Birbal Sahni Institute of NARINDER CHOPRA.

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A TECHNIQUE FOR STUDYING pH CHANGES PRODUCED BY CELLULOLYTIC FUNGI IN CELLULOSE SUBSTRATE

THE ability of cellulolytic micro-organisms to produce acid during digestion of cellulose substrates is well known and indeed, has been employed as the basis for the detection of their activity on various cellulosic material. Whilst, it may be useful to study the changes in pH in the cellulose substrate which are attacked by different cellulolytic micro-organisms, none of the existing methods lend themselves suitably to such an investigation. The primary difficulty seems to be in the availability of a pure cellulosic material in which pH changes can be readily studied. A cellulose medium incorporated with agar and a dye, commonly employed,¹ would hardly fulfil the purpose of a pure cellulose substrate. Another difficulty encountered is the inability of some micro-organisms to decompose filter-paper cellulose. Recent work by the author² has shown that although many species of *Fusarium* were unable to breakdown filter-paper they readily decomposed bacterial membranes synthesized by *Acetobacter xylinum* which is known to be a pure form of cellulose. It was also observed that the technique of employing bacterial cellulose as substrate for determining cellulolytic activity could be employed usefully for studying pH changes occurring in the substrate during the growth of micro-organisms.

Cellulose discs were prepared as described earlier.² After autoclaving, one such disc was placed in a sterile 10 cm. Petri dish and inoculated in the centre with *Fusarium culmorum* (test organism). Duplicate series, each with three inoculated dishes and three uninoculated controls, were maintained for each treatment. After incubation the cellulose discs with the fungal colony and the uninoculated controls in one series were treated with B.D.H. Universal Indicator. A few drops of the indicator solution was gradually pipetted on the membrane so as to cover the entire surface, the excess

drained off and after 10-15 minutes interval the dishes were held over a white background in good light and the colour produced in the substrate matched with the corresponding colour chart. The colour developed gave the approximate range of pH variations in the substrate. The narrow range indicator, specific for the range of pH observed, in the cellulose substrate, was then used on the duplicate series of discs. A gradient in colour change was seen to occur, beginning from the point of initial growth of the fungus to the periphery of the mycelium. The original pH of the substrate at 6.0 changed to 5.0-5.5 in the area covered by *F. culmorum* colony after 5 days' growth at 25-29° C. Acidity was greatest in the centre of the disc and gradually decreased up to the periphery of the colony, the pH remaining unaltered therefrom. The acid secreted by the growing mycelium of the fungus did not diffuse to a point further than 3-5 mm. from the hyphal tips. The technique was found to be simple, accurate and had the advantage of employing pure cellulose as substrate. The initial pH as well as the nutrient status of the substrate were also readily modified by altering the composition and pH of the mineral solution to which the bacterial membranes were treated² prior to inoculation. When the initial reaction of the membranes was adjusted to pH 3.0, 4.0, 5.0, 6.0, 7.0, 8.0 and 9.0, the substrate under 5-day old colony of *F. culmorum* had a pH of 4.0, 4.5, 4.5-5.0, 5.0-5.5, 5.0-5.5, 6.5-7.0, 7.0-7.5 respectively.

This work was carried out at the University Botany Laboratory, Madras. The author thanks Prof. T. S. Sadasivan for his criticism and interest in this work and the Government of India, for the award of a National Research Fellowship.

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OCCURRENCE OF DIATOMS IN THE LEAF OF *SPIRODELLA POLYRRHIZA* SCHLEID.

WHILE examining the section of the leaves of *Spirodella Polyrrhiza* (an aquatic plant of the family Lemnaceæ, which was growing abundantly in the Laboratory lysimeters of the Botany Department of Annamalai University) diatoms were found to occur in the cells of the

upper epidermis, air-cavities and also inside the mesophyll tissues. These diatoms were of semi-lunar configuration with prominent raphe exhibiting sluggish movement. The older the leaf the more the number of diatoms it contained. Dead leaves contained the maximum number and the youngest had practically none. Slow dying of *Spirodella Polyrrhiza* in the lysimeter was noticed and the complete extinction of the plants occurred within a month. Perhaps the entry of the diatoms in the leaf tissue might have adversely affected the metabolism of the plant and brought about its death.

The diatoms "Cymbella" were the main inhabitants, though a few other types of diatoms were also there. So far endophytic type of diatoms in aquatic plants have not been observed and recorded.

The author is grateful to Dr. T. C. N. Singh and Prof. M. O. P. Iyengar who confirmed the above finding.

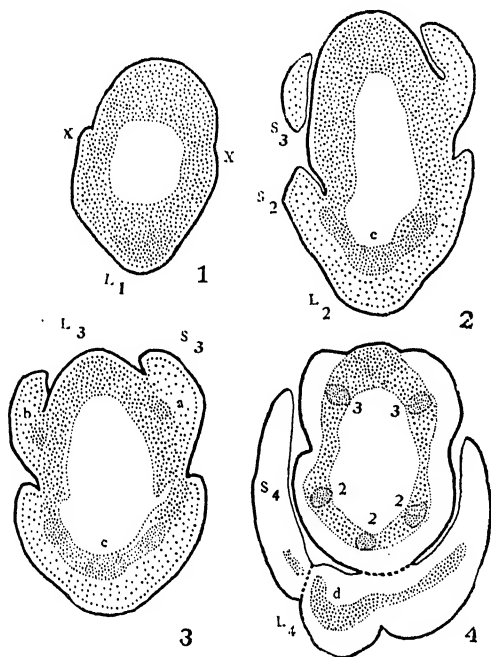
Department of Biology. G. LEELAKRISHNAN.
Sri Venkateswara College,
Tirupati,
December 15, 1958.

VASCULAR SUPPLY FOR THE STIPULE IN *CAYRATIA CARNOSA* GAGNEP

ACCORDING to Sinnott and Bailey,¹ each stipule obtains its vascular supply from the branches derived from the corresponding lateral traces of the associated leaf. Majumdar,²⁻³ after reviewing the past work on stipules concluded that the laterals after their departure from the axial cylinder run parallel through the axial component (the foliar foundation when wholly included in the shoot axis is termed by him as the axial component) and shift towards the median. He also concluded that if these laterals branch, they give rise to the stipules. Following observations will indicate that even in the absence of the branching of the laterals, stipular initiation can occur.

The writer in the course of his investigations on origin and development of stipules in some species of Vitaceæ observed a type of stipular vascular supply in *Cayratia carnosæ* (syn. *Vitis trifolia* L.), which, as far as he is aware, is hitherto not reported. Figure 1 shows a first foliar primordium (L_1) and the two lateral swellings (X), formed by periclinal divisions in the axis, which are the earliest signs of stipular initiation observed. The second leaf and its stipules typifying a later stage arise as a three-lobed structure, the central one giving rise to the petiole and the blade and the lateral lobes as

stipules. Figure 4 shows that the leaf receives three trace bundles, one median and the two laterals. The most interesting fact is the behaviour of the two laterals. These two traces as they depart from the axis enter the stipular



FIGS. 1-4. Serial transections of shoot apex showing the leaves (L₁, L₂, L₃ and L₄) and their respective stipules (S₂, S₃ and S₄) from the terminal apex, $\times 290$. a, b—Indistinct lateral traces for the third leaf; c—vascular supply of the second leaf and its stipule; d—vascular tissue of the fourth leaf and its stipule; 2—procambium strands of the second leaf-trace; 3—procambium strands of the third leaf-trace.

tissue and traverse obliquely (Figs. 2, 3). They converge with the median one, opposite the leaf-base and form the foliar vascular supply (Figs. 2, 3, 4). It is evident that the initiation and development of the stipules at this stage are due to the stimulating influence of the two laterals. Sinnott and Bailey¹ have correctly emphasised the morphogenetic connection between lateral leaf-trace and stipule. But the most significant observation is that the stipular initiation is not due to any vascular supply that arises as a branch from the lateral trace of the leaf. In fact the stipular primordia in their early stages appear as if they were the two basal lobes of the leaf, vascularised by the lateral traces. The fuller details and discussions will be published elsewhere.

My sincere thanks are due to Professor

T. C. N. Singh, Head of the Department of Botany, for facilities.

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Annamalai University,
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September 27, 1958.

J. J. SHAH.

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A NOTE ON THE CHROMOSOMES OF *ORYZIAS MELASTIGMA* (McCLELLAND)

AMONG the vertebrates, as Bungenberg¹ has pointed out, the fishes are the least known cytologically, owing to technical difficulties and to small size of the chromosomes. Of the 560 species of cytologically known vertebrates, only about 95 are fishes and according to Makino² these do not include a single Indian species.

The present note describes the chromosomes of *Oryzias melastigma* from squashes and from sections of early cleavage stages. The chromosome number has been determined from metaphase plates.

There are 24 pairs of chromosomes. Of these 7 pairs are acrocentrics. Of the metacentric chromosomes, 12 pairs are 'V'-shaped with more or less equal arms and with median centromeres. The remaining 5 pairs are 'J'-shaped, one pair with median centromere, the rest all having subterminal centromeres. All the chromosomes are well defined, no heterochromosome being present.



FIG. 1. Camera lucida drawing of the metaphase chromosomes of *Oryzias melastigma*—aceto-orcein squash, $\times ca. 2,000$.

The chromosome number in different species of Cyprinodonts varies from $2n = 36$ to 48. The chromosome complement of *Oryzias melastigma* is similar to that of the Japanese species *Oryzias latipes*. $2n = 48$ is also found in *Xiphophorus hellerii* and *Platycephalus maculatus*.

In the metaphase plates the chromosomes appear to be telomitic and atelomitic structures with median, submedian and subterminal centromeres. But the morphological nature of these

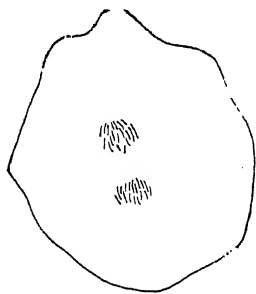


FIG. 2. Camera lucida drawing of the early anaphase chromosomes of *Oryzias melastigma*—one optical section represented, \times ca. 6,500.

chromosomes during early anaphase presents a different picture. The chromosomes during the early anaphase appear as clearly rod-shaped structures of varying lengths in contrast to the telomitic and atelomitic metaphase chromosomes with submedian and subterminal centromeres. Makino² has pointed out that the strongly curved and 'V'-shaped appearances of the metaphase chromosomes of Stickleback is only a temporary phase. The present study also indicates that the metaphase curving does not indicate the real nature of the chromosomes which are really rod-shaped as the anaphase reveals.

My thanks are due to Professor R. V. Seshaiya, Director, Marine Biological Station, Portonovo, for suggesting the problem and for guidance and instruction, and to Government of India, Ministry of Education, for the award of a Senior Research Scholarship.

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INDEPENDENT ORIGIN AND DEVELOPMENT OF THE CRYSTAL- LINE LENS IN GASTEROSTEUS ACULEATUS (L.)

THE experimental work on Amphibia^{1,4} shows that if the eye cup is removed at the tail bud stage, the lens is not formed. Further, the eye cup induces the formation of a lens out of epidermal tissue which would normally not have given rise to a lens at all. It is, therefore, concluded that the formation of the vertebrate lens is under the influence of the eye cup. However, there are a few exceptions. When the developing eggs of *Fundulus heteroclitus* are subjected to the action of magnesium salts, alcohol or other anaesthetic agents, the normal outgrowth of the optic vesicles is generally inhibited but the lens does differentiate from the epidermis.⁵ In *Rana esculenta*, the removal of the eye rudiment at the early neural fold stage does not prevent the formation of a lens.⁶ A similar effect is produced when the eggs of *R. esculenta* are treated with low temperatures and the lens is formed in the absence of an eye cup.⁷

Gasterosteus aculeatus resembles *F. heteroclitus* and *R. esculenta* in this respect as shown by the present experiment.

The adult specimens of *G. aculeatus* were obtained from a near-by pond at Oxford and brought to maturity in the laboratory aquaria.

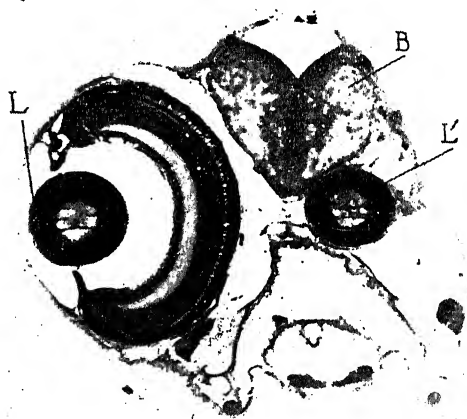


FIG. 1. Transverse section of the larva of *Gasterosteus aculeatus* showing monophthalmic condition. Mag., \times 108. B = Brain, L = Lens of normal eye, L' = Lens developed without the eye cup.

The eggs stripped from a ripe female were fertilized by the dry sperm method of artificial insemination and immediately after, were subjected to cold or hot shock treatments. For

cold shock, the eggs were subjected to a temperature of 0° C. for three hours and for hot shock to a temperature of 32.5-37° C. for five minutes. The treated eggs were then allowed to develop in an apparatus specially constructed for the purpose.⁸ The embryos which hatched out showed various types of microcephaly. It is interesting to note that monophthalmic condition was produced only in the embryos developed from the cold shocked eggs. One such embryo showing monophthalmic condition developed into an advanced larva. A section passing through the eye region of this larva (Fig. 1) shows that the lens has developed in spite of the fact that the eye cup of that side is absent. The following peculiarities have been noted in the present case:

- (i) The self-differentiated lens is but very slightly smaller in size than the normal one.
- (ii) The part of the brain which should have differentiated the eye cup is almost normal.
- (iii) The self-differentiated lens is touching the brain on one side and the epidermis on the other.

An event of this nature may be explained in one of two ways. The determination of the lens occurs precociously, i.e., the lens is determined by the presumptive eye rudiment at an early neural plate stage. The second explanation is that the optic lens may be looked upon as a once independent organ which has become closely associated with the nervous elements of the eye, that it has to some extent lost its tendency to arise independently, although still capable of doing so under certain conditions.

My thanks are due to Professor Sir Alister Hardy, F.R.S., and Dr. M. Fischberg, for their kind help and facilities in the Department of Zoology and Comparative Anatomy, Oxford.

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OCCURRENCE OF MONONCHUS SP. (FAM. MONONCHIDÆ: TRIPYLOIDEA) A PLANT NEMATODE FROM INDIA

SOMETIME ago the Superintendent, Wynaad Colonization Scheme, Ambalavayal, Kerala State (South India), reported to the Zoological

Survey of India decline of Mandarin orange trees and sought the help of the Department in identifying the round worms suspected to be responsible for the decline. It was stated that the declining orange trees invariably developed a sort of root peeling and root rot, and microscopic examination of the affected roots disclosed the association of round worms. It was reported that these worms manifested themselves soon after the monsoon set in that region. It was further stated that the foliage showed signs of yellowing and that worms were far less in number in trees well manured, the roots of which were protected by plenty of organic matter than in poor soil and unattended trees.

The mandarin orange roots were examined in detail after the receipt of the material from the above authorities. The root peeling and root rot were observed. When these root peelings and root rots were teased and examined under the microscope, they were found to contain round worms associated with certain arthropod larvæ and some minute earthworms. The worms were found to infest even the finest rootlets. The epidermal layer of the roots were also found to get lacerated and torn and ultimately the bark of the roots peeled off in very fine layers. The worms were found in large numbers in roots which showed signs of rot and disintegration and comparatively less in roots which did not show any decline.

These round worms (eel worms) are identified as *Mononchus* sp., a predatory nematode, belonging to the genus *Mononchus* Bastian, 1865. Though the species of *Mononchus* appear to be of common occurrence all over the world, this worm has been recorded for the first time from India.

The author wishes to convey his thanks to Dr. B. S. Chauhan, Officer-in-charge, Helminthology Section of the Zoological Survey of India, for encouragement and guidance, to Dr. J. B. Goodey of Rothamsted Experimental Station (U.K.), for the identification and to the Superintendent, Wynaad Colonization Scheme, Ambalavayal, for having supplied the material.

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ACTIVATION OF PIGEON PANCREATIC LIPASE BY MERCURIC CHLORIDE

THE occurrence of a lipase in the *Pectoralis major* muscle of the pigeon was reported in an earlier paper.¹ Subsequently it was decided to study the properties of this lipase and the pancreatic lipase of the same animal with a view to comparing them. A detailed account of the study is reserved for a future communication. Here we report the behaviour of the pancreatic lipase in the presence of mercuric chloride. Barron and Singer² have classified pancreatic lipase and esterases under sulphhydryl enzymes. Ions of heavy metals such as Hg are said to inactivate such enzymes by combining with reactive —SH groups forming mercaptide compounds. Such inactivation can be reversed by the addition of BAL*,² because of its greater affinity for the metal. In our attempt to confirm this in the case of the pancreatic lipase of the pigeon we found, contrary to our expectation, that small concentrations of the metal activates the enzyme to the extent of 600% and is inactivated by BAL.

The enzyme we used in our study was an aqueous extract of ether defatted dry powder of the pigeon pancreas. The pancreas removed after decapitating the animals was cut into small pieces and dried at room temperature *in vacuo* over calcium chloride. Dehydration was complete within 24 hrs. The dry tissue was turned into a powder by crushing in a mortar, sieved through fine silk, treated with a large quantity of cold ether for 1 hr., filtered and dried at room temperature till all the ether was removed. 10 mg. of this powder was extracted in 5 ml. distilled water in cold for 1 hr., centrifuged at about 2,500 r.p.m. and the supernatant used as the enzyme solution. One ml. of this extract contained 0.6–0.7 mg. protein. The nitroprusside reaction and the lead-blackening test gave negative results with this extract indicating the absence of —SH or —S—S—groups. BAL formed an insoluble blue green precipitate with this solution which according to the description of Webb and van Heyningen³ is a BAL-iron compound. The precipitate was ashed and the ash taken up in 3 N HCl. This solution was found to contain large quantities of iron.

The lipolytic activity of the extract was manometrically determined according to the method followed in an earlier study.⁴ The activity of the enzyme at different concentrations of the

mercuric chloride is shown in Figs. 1 and 2. The mercuric chloride used was a recrystallized pure sample. All the other chemicals used were of analytical grade.

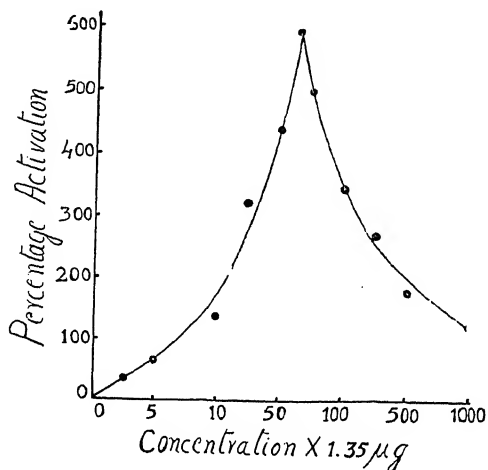


FIG. 1. Activation of pigeon pancreatic lipase by mercuric chloride at low concentrations.—Bicarbonate- CO_2 buffer, pH 7.4, temp. 37°C ., gas phase 95% N_2 +5% CO_2 . Flask contents—1.5 ml. 0.025 M NaHCO_3 , 0.5 ml. HgCl_2 to give the above concentration and 0.5 ml. enzyme in the main chamber and 0.5 ml. 4% tributyrin in 0.0148-M NaHCO_3 emulsified with Tween 80 in the side arm, in a total volume of 3 ml. Control flask had 0.5 ml. H_2O in place of HgCl_2 . Duration of the experiment 1 hr.

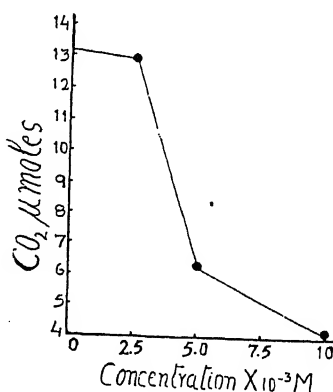


FIG. 2. Inhibition of pigeon pancreatic lipase by mercuric chloride at high concentrations. Conditions same as for Fig. 1.

It can be seen that the activation is maximum between concentrations 90–100 μg. of the salt. This increase in activity of the enzyme was also found when the enzyme was pre-incubated with the same concentrations of the salt. Thereafter the activity decreases with increasing concentra-

* Abbreviations used—BAL, British-Anti-Lewisite (2:3-dimercaptopropanol), PCMB, *p*-chloromercuribenzoate.

tions of mercuric chloride. Even at a final concentration of 10^{-2} M in the 3 ml. content of the flask the inhibition is only 66%.

Activation of an enzyme by mercuric chloride is something unknown. No attempt has been made to study the physical chemistry and chemical kinetics of this activation. It should be noted that PCMB at all concentrations is inhibitory. Complete inhibition was obtained at a final concentration of 2×10^{-3} M in the reaction flask. The inhibition by PCMB and mercuric chloride at high concentrations is not due to the formation of mercaptides because it was found that the enzyme does not contain any trace of sulphur. The usefulness of these substances in the detection of $-SH$ groups in protein is therefore limited. Barron² has reported that heavy metals which form mercaptide can also combine with the NH_2 groups of protein. However the activation of the pigeon pancreatic lipase by mercuric chloride at low concentrations is difficult to explain. May be that it binds some inhibitors already present in the extract and brings about an activation.

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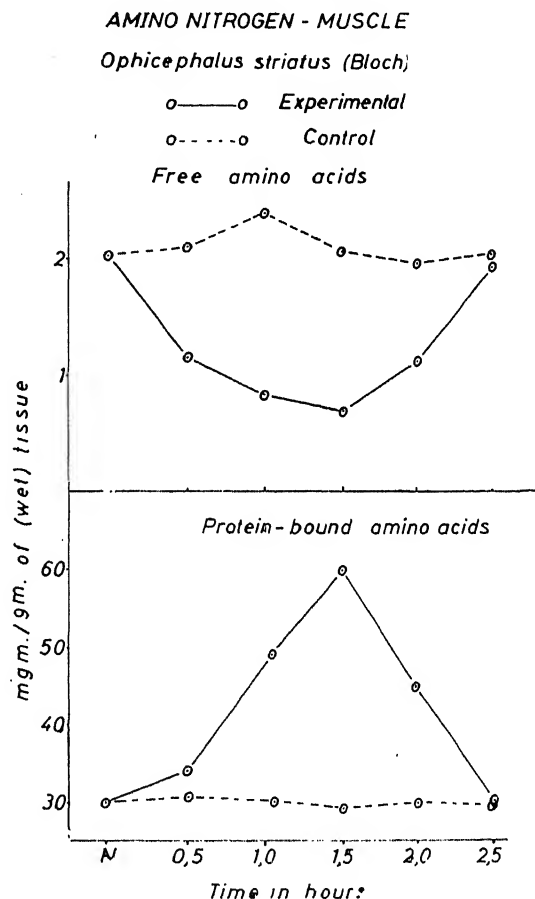
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EFFECT OF INSULIN INJECTION ON THE AMINO NITROGEN CONTENT OF FREE AND PROTEIN-BOUND AMINO- ACIDS IN THE SKELETAL MUSCLE OF THE MURREL—OPHICEPHALUS STRIATUS (BLOCH)

LOTSPEICH,¹ who studied the effect of insulin injection on the amino-acids of blood and muscle in the dog, found that there was a proportional correlation between the fall of the free amino-acids in the blood and the rise of protein-bound amino-acids in the muscle following the injection of insulin. From this he concluded that insulin promotes protein synthesis. Best *et al.*² have pointed out that evidence indicating that insulin promotes protein anabolism has been accumulating in recent years.

The effect of insulin on the carbohydrate and protein metabolism in the fish *Ophicephalus striatus* (Bloch), has been studied. A cold-blooded animal is in some respects better suited for these studies than mammals. Observations show that following injection of insulin, the amino nitrogen of the free amino-acids shows a fall, and this is accompanied by a corresponding rise in the amino nitrogen of the protein-bound amino-acids of the muscle of the fish.

Intra-muscular injection of 5 units of insulin was given to specimens weighing about 150 to



200 gm. As control experiments a separate batch of fish were injected with 2.5 ml. of distilled water. At the end of 0.5, 1.0, 1.5, 2.0 and 2.5 hours after insulin injection the specimens were dissected and the skeletal muscle weighing about 0.2 gm. was immediately taken for analysis. Extracts were prepared following the procedure adopted by Russel and Long³ for the estimation of amino nitrogen of free amino-acids. Tissues were hydrolysed with 6N HCl and extracts were prepared following the method adopted

by Giri *et al.*⁴ Amino nitrogen estimations were carried out following Pope and Stevenson's method as modified by Block and Bolling⁵ and values were expressed in mgm./gm. of tissue. Four sets of experiments were carried out for each stage and the mean values are represented in the graph.

The percentage of fall of the amino nitrogen of the free amino-acids, the percentage of increase of that of protein-bound amino-acids and the percentage of recovery of both are shown in Table I.

TABLE I

Amino nitrogen	Duration (in hours) after insulin injection				
	0.5	1.0	1.5	2.0	2.5
Free amino-acids	48.16	58.83	60.89	56.39	95.10
	F	F	F	R	R
Protein-bound	13.70	63.76	83.23	50.57	95.00
	I	I	I	R	R

F: % of fall. I: % of increase. R: % of recovery.

Graph shows the effect of insulin injection on the amino nitrogen of free and protein-bound amino-acids. For the free amino-acids, the decline of the amino nitrogen lasts for 1.5 hours when the amino nitrogen content is at a minimum. This declining phase is followed by the recovery phase. At the end of 2.5 hours following the injection, the amino nitrogen content of the free amino-acids recovers to about 95.10% of the normal value. It will be seen that in the control experiments there is no significant change in the amino nitrogen content of free amino-acids.

With regard to the protein-bound amino-acids, the amino nitrogen content increases after injection. At the end of 1.5 hours—the maximum is reached showing an increase of 83.23%. Then the decline towards normality follows, the amino nitrogen recovering to 95.0% of the normal value.

The graph shows the striking parallel between the progressive fall and recovery of the amino nitrogen of the free amino-acids on the one hand and the progressive increase and decline of that of the protein-bound amino-acids. The correspondence is sufficiently close and significant to warrant the inference that the injection of insulin increases the synthesis of protein at the expense of the free amino-acids in the skeletal muscle. The reverse process evidently occurs during the recovery to normality.

My thanks are due to Professor R. V. Seshaiya, Director of Marine Biological Station, Portonovo,

for suggesting the problem and for guidance. My thanks are also due to the Ministry of Education, Government of India, for the award of a Senior Research Scholarship.

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AGE-DETERMINATION OF THE INDIAN OIL-SARDINE, *SARDINE LONGICEPS* VAL. BY MEANS OF SCALES*

DIVERGENT opinions have been expressed in the past regarding the age of the Indian oil-sardine.¹⁻⁵ Recent work on some Indian oil-sardines has shown that the scales can be used for age determination. A detailed study of the oil-sardine was, therefore, undertaken to see the extent to which they could be used for determining the age of the fish.

The material for the work was collected from Calicut from January 1957 to August 1958. A careful examination of the scales of the oil-sardine showed that the same lines as was done by Phillips⁶ on *Sardinia caerulea*. It was observed that the scale region just above the tip of the pectoral fin were the most reliable for this work. Accordingly six scales from each of 1,370 fish were studied in detail.

The disposition of circuli in the scales was more or less horizontal. The centre of the focus of the scale was not quite distinct. The ring, when present, was seen as a semicircular mark concentric with the scale-margin, breaking the continuity of the circuli; occasionally, a ring might be broken into segments. While generally well-defined, the rings were not quite clear in a few cases. Besides the true rings, certain false rings, similar to those described by Walford and Mosher⁷ in *Sardinia caerulea*, were noticed in a few scales.

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

TABLE I
Table Showing Distribution of Rings

	Size groups (in cm.)*														
	7.0 to 7.9	8.0 to 8.9	9.0 to 9.9	10.0 to 10.9	11.0 to 11.9	12.0 to 12.9	13.0 to 13.9	14.0 to 14.9	15.0 to 15.9	16.0 to 16.9	17.0 to 17.9	18.0 to 18.9	19.0 to 19.9	20.0 to 21.0	
No. of fish examined	4	10	7	..	..	110	349	301	103	144	163	114	41	24	
No. of rings 0	4	10	3	..	..	33	142	120	18	5	1	1	..	..
1	..	..	4	..	..	74	206	177	67	71	49	24	6	3	
2	..	..	..	..	..	3	1	4	17	67	93	75	30	15	
3	..	..	..	..	..	..	..	..	1	1	20	14	5	6	
Average No. of rings	0	0	0.57	..	..	0.73	0.60	0.61	1.01	1.44	1.80	1.90	1.98	2.13	

* Total length from tip of snout to tip of dorsal caudal fluke.

It is obvious from Table I that the scales from the sardine below 8.9 cm. do not have any ring and that above that size the average value of the rings increases in general with the increasing size of the fish. Scales with one, two and three rings make their appearance at the sizes of 9.9-9.9, 12-12.9 and 15-15.9 cm. respectively. The one-ring class predominates up to 16-16.9 cm. group and the two-ring class thereafter, the fish with three rings in their scales being small in number. It has been observed that the period of ring formation is May-July and it appears that only one ring is formed every year. The presence of three rings in the large-sized fish suggests that they may be in the fourth year of their life.

The percentage length-frequency distribution studied separately indicates three distinct modes at 12.0, 16.0, and 18.0 cm. for the year 1955-56 and at 12.0, 17.0 and 19.0 cm. for 1956-57. For 1957-58 there are two modes at 13.0 and 16.0 cm., the third mode being not clear owing to the absence of adequate number of large fish in the catches.

It is evident from the above that the results obtained by length-frequency analyses and study of scale-rings of the fish are in agreement to some extent. It may, therefore, be reasonable to assume that these rings may prove useful in the determination of the age of the sardine. The work is in progress and details will be published in due course.

My grateful thanks are due to Dr. N. K. Panikkar, Dr. S. Jones, Shri R. V. Nair and Dr. G. Seshappa for their valuable suggestions and helpful criticism.

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CHANGES IN THE FREE AMINO ACIDS OF RICE SEEDLINGS INDUCED BY LOW TEMPERATURE AND H₂S

ONE of the major problems of rice producing countries is the periodical outbreak of the so-called "browning disease" of rice (brusone, aki-ochi). According to the prevailing opinion the disease is caused by the fungus *Piricularia oryzae*. However, an important role must be attributed to some environmental factors favouring disease development, like abundant N-supply, lack of sunshine combined with low temperature, increase of H₂S in soil. Under these circumstances the fungal infection appears secondarily when a "physiological weakening" of the host plant has already taken place.¹ Of the factors favouring disease development the effect of low temperature (12 to 14° C.) and H₂S on the free amino acid content of rice seedlings was subjected to detailed studies. These investigations were warranted by a number of observations made by earlier authors on disturbances in N-metabolism in diseased plant tissues. In plants infected with facultative parasites often a shift of the ratio, soluble N/protein N, has been found.² Therefore, a study of the effect of the abovementioned factors favouring the outbreak of disease has been undertaken in order to find

out whether or not a change of a similar nature could be observed in plants predisposed to disease.

Rice seedlings were grown in sand culture for 16-18 days and then transferred for the experiments to a modified Hoagland solution at pH 6.5. The quantitative assay of amino acids was carried out as previously described.³

The changes in amino acids due to low temperature are essentially the same as those characteristic to plant tissues attacked by parasites. The abnormal accumulation of basic amino acids, playing a major role in protein synthesis, seems to be of particular interest (glutamic and aspartic acids and their amides). The amount of some other amino acids (alanine, γ -amino butyric acid, tyrosine, etc.) underwent practically no changes. As shown by our experiments the lowering of temperature resulted only in a partial inhibition of uptake of N-compounds by the seedlings. Therefore, the above results may be interpreted as to show that low temperature inhibits primarily the protein synthesis, whereas the conversion of inorganic N into amino acids has also been observed in the endosperm. This seems to indicate that the translocation of amino acids is more seriously inhibited by low temperature than their mobilisation.

The effect of treatment of rice seedlings with H_2S (H_2S was bubbled through the nutrient solution for 3 hours) gave entirely different results. In contrast to the findings of Mitsui

et al.⁴ no uptake of N compounds was observed in H_2S -treated plants. However, as shown in Fig. 1, the relative amount of amino acids changed considerably. A comparison of the chromatograms A and C with D and F clearly indicates that some amino acids in the treated plants practically disappeared (glutamic and aspartic acids, glutamine) whereas the amount of some others slightly increased (alanine, γ -amino butyric acid). It is logical to hypothesize that the increase in these 2 amino acids is due to a transamination process, the amino groups being transferred from glutamine and aspartic acid. H_2S apparently did not inhibit transaminations. Therefore, the changes in N-metabolism induced by H_2S are different from those induced by low temperature, although both favour the outbreak of brusone. Further biochemical studies are necessary to elucidate the mechanism of action of the various factors playing a role in the development of the browning disease of rice. Our own studies will be extended to an investigation of the effect of H_2S on the transaminase of rice *in vitro*.

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TORULA STAGE OF HENDERSONULA TORULOIDEA NATTRASS ON TWIG OF PSIDIUM GUAJAVA L.—A NEW RECORD

FROM the twigs and branches of deciduous trees showing symptoms of wilting and die-back in Egypt, Nattrass¹ isolated the fungus *Hendersonula toruloidea* Nattrass and in 1933 described its *Torula* and pycnidial stages found in artificial media and nature. In 1947, Wilson² described the *Torula* stage of the fungus causing branch wilt disease of Persian walnuts in California, as *Exosporina fawcetti* Wilson, but later studies by him revealed that *E. fawcetti* sometimes forms pycnidia and it was the conidial stage of *H. toruloidea* Nattrass.

In the month of August 1957, twigs of guava (*Psidium guajava* L.) plants in an orchard near Kota (Rajasthan) were observed to show

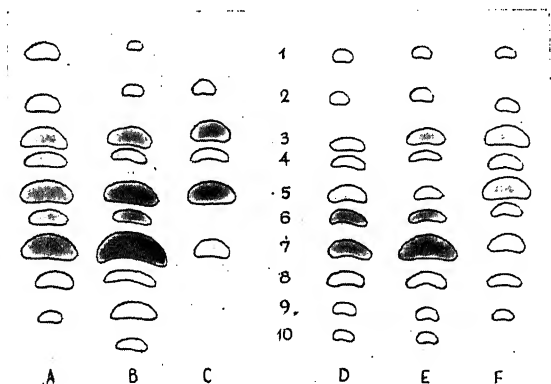


FIG. 1. The amino acids of root and leaf tissue. ABC = root, DEF = shoot, AD = control (start of experiment, before the transfer of seedlings to the nutrient solution) BE = plants in nutrient solution aerated for 3 hours, CF = plants in nutrient solution treated with H_2S for 3 hours. 1 = leucine, 2 = valine, 3 = γ -aminobutyric acid, 4 = tyrosine, 5 = alanine, 6 = glutamic acid, 7 = aspartic acid + glutamine, 8 = histidine, 9 = glutathione, 10 = cystine.

symptoms of die-back, drying and defoliation (Fig. 1). Isolations from affected tissues almost



FIG. 1. Diseased twigs of guava.

invariably yielded the pure culture of a fungus, which was studied and identified as *Torula* stage of *Hendersonula toruloidea* Nattrass.

On potato dextrose agar (2%) medium, the fungus starts with a white pulverulent aerial growth, later turning to smoke-grey and ultimately black in colour. The hyphae are 2.7-9 μ

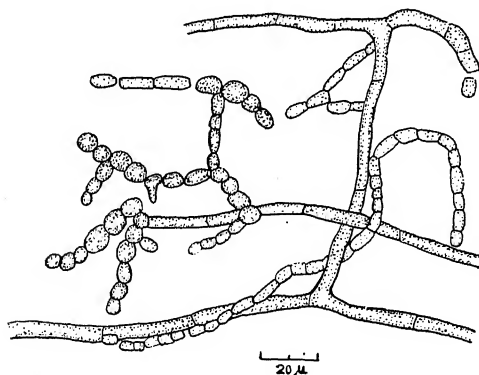


FIG. 2. Hyphae and conidia of *Hendersonula toruloidea* Nattrass.

broad, mostly septate, irregularly branched, hyaline when young, turning to olive to olive grey colour in 3 to 4 days. Short-branched convolute hyphae arise from the agar surface, become septate throughout their length

and produce chains of conidia (thallospores or arthrospores) in abundance within 48 hours of inoculation (Fig. 2). The conidia, when mature, are olive to olive brown in colour, smooth-walled, globose, ovoid, wedge-shaped. Single-celled, 3.6-14.4 μ long (average 7.3 μ) and 2.7-9 μ broad (average 3.9 μ).

The fungus also grew and sporulated well on cornmeal, oatmeal, Brown's, Dox's and Richard's agar media. The optimum temperature for fungal growth was found to be between 30 and 35° C.

The fungus under study closely resembles *Torula* stage of *H. toruloidea* Nattrass. The pycnidial stage has not been found so far in nature or in our culture on artificial media. The culture has been deposited in the culture collection of the Mycology Division of the Indian Agricultural Research Institute, New Delhi.

Authors are grateful to the Director, Commonwealth Mycological Institute, Kew, for identification of the fungus, to Dr. N. Prasad, Plant Pathologist for his guidance and to Shri Samrath Raj, Director of Agriculture, for providing facilities of work.

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R. D. SINGH.

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ROOT KNOT NEMATODE ON COLOCASIA

DURING autumn of 1957, 'root knot' like galls were observed on the roots and corms of *Colocasia antiquorum* Schott., at the Central Potato Research Station, Patna. Microscopic examination of the infested tissues revealed the presence of a large number of nematodes, which were identified to be *Meloidogyne javanica* (Treub) Chitwood. The only reference of 'root knot' on *C. antiquorum* is one of an unidentified species of *Meloidogyne* (formerly called *Heterodera radiculicola*) by Nagakura (1930). In India *C. antiquorum* was not mentioned as a host of 'root knot' nematodes by Baylis (1936), who reported them under *Heterodera marioni* (Cornu) Goodey, on a number of field crops.

The nematode infestation on the young roots appears as small irregular knots. In the older roots, the injury produces warts with local thickenings throughout their length. In cases of heavy infestation, thick prominent galls are

formed on the roots (Fig. 1). In the corms the infestation appears first as small tubercles, but

for the identification of the nematode and supply of valuable information.

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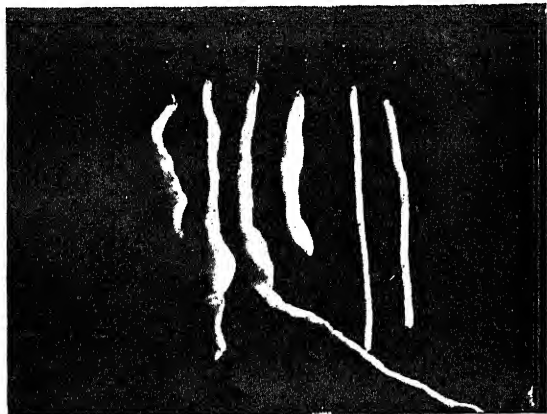


FIG. 1. Roots of *Colocasia antiquorum* Schott. Four on left infested by *Meloidogyne javanica* (Treub) Chitwood. Two on right free of infestation.

heavy and localised attack leads to gall formation (Fig. 2).



FIG. 2. Corms of *Colocasia antiquorum* Schott. One on left free from nematodes. Two on right infested by *Meloidogyne javanica* (Treub) Chitwood.

The galls were observed to be filled with pear-shaped adult females, numerous egg masses in different stages of development and a few males. Sometimes the glistening white females embedded in the tissues of *C. antiquorum* may be seen with the naked eye, when an infested corm is cut across.

I am grateful to Dr. Pushkarnath, Director, Central Potato Research Institute, Simla, for his keen interest and encouragement. My sincere thanks are also due to Dr. Mary T. Franklin of the Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, U.K.,

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USE OF HORMONES TO INDUCE ROOT GROWTH ON FRUIT PLANT CUTTINGS

QUITE a lot of our fruit and flower plants are propagated through cuttings, but some of them like sour lime and plum often do not strike roots so easily as others and to ensure their establishment such cumbersome and expensive methods as layering, goottee, and grafting have to be resorted to. Researches in other countries have pointed to the fact that treatment of cuttings with hormones induces rooting, but very little work has been done on this line in India. The propagation of grape (*Vitis vinifera*), sweet lime (*Citrus limettoides*), sour lime (*Citrus aurantifolia*), and plum (*Prunus domestica*) has been a great problem and therefore, such investigations were greatly wanting. It was in this background that the present experiments were conducted in a sandy loam field at Ludhiana during 1950 and 1951. A total of 9,600 cuttings of the above four fruit plants were used.

The cuttings were prepared from one year old wood of uniform length of about 9" with about the same thickness and carrying about the same number of buds. The cuttings in case of *Citrus* species were stripped of all the leaves. The treatments given to these cuttings were the application of (i) alpha-naphthalene acetic acid, (ii) 3-indole acetic acid, and (iii) B-3-indole propionic acid with a dose of 4,000 ppm. in Talc. powder.

To study the effect of various hormones on the rooting of these cuttings, time taken between callus formation and root formation and then, number, length and thickness of roots were studied. The data were analysed statistically, and the following results were arrived at from this investigation.

1. Callus formation in hormone treated cuttings took place earlier than in untreated ones and consequently rooting in almost all the fruit species under trial was hastened by about a week.

2. Sweet lime and sour lime treated cuttings planted in the month of August gave rooting three weeks after the date of planting whereas the cuttings planted in February gave rooting 8 weeks after planting.

3. The roots on the hormone treated grape vine cuttings were found scattered all over the underground portion of the cuttings, whereas in untreated cuttings roots were confined to the basal portion of the cuttings.

4. In plum, sweet lime and sour lime, roots were confined to the basal portion of the cuttings in both treated and untreated.

5. There was greater number of roots and roots were longer and thicker in size and profusely branched on cuttings treated with hormones than on untreated cuttings of all the fruit plants under trial.

6. 3-Indole acetic acid in this respect was found to be the best hormone followed by B-3-indole propionic acid, and alpha naphthalene acetic acid, for grape vine and plum. In sweet lime also 3-indole acetic acid gave the best results followed by alpha-naphthalene acetic acid, B-3-indole propionic acid and control.

7. Although sour lime cuttings were induced to rooting by the hormone treatments to a certain extent the results were not encouraging.

The above information will prove useful for the progressive fruit growers as well as the nurserymen. The author will be glad to receive comments from any readers who may be working on similar problems or may be interested in this line.

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A SERIOUS ATTACK OF *SITOTROGA CEREALELLA* OLIV. ON STANDING CROPS OF CHOLAM AND RAGI AT COIMBATORE

Sitotroga cerealella Oliv. is an important pest found on stored grains of paddy, cholam and maize. It is also reported to attack stored wheat, barley, oats, etc., in other countries. The adult is a tiny-grey moth with fringed hindwings and often found in numbers flying inside infested granaries. The larva of this moth does serious damage to stored grains by boring inside and turning them into chaff. This insect is chiefly a pest of stored grains, but it has also been reported to attack developing grains in the field in the case of wheat, maize, barley, oats, etc., in other countries. Fletcher (1921) mentions that it occasionally occurs in

the field on ripe ears of paddy and cholam. Puttarudriah and Raju (1953) have reported the occurrence of this insect on earheads of cholam in the field at Mysore.

Recently during June and July 1958 this pest occurred in a serious form on standing crop of cholam (*Sorghum vulgare*) and Ragi (*Eleusine coracana*) at the Central Farm attached to the Agricultural College & Research Institute, Coimbatore damaging the ears of both the crops. The earheads were found to harbour a good number of caterpillars which were noticed tunnelling and feeding on the ripening grains. Attacked earheads were reduced to a powdery mass of damaged grains and frass. This kind of damage was found in a large area in the Central Farm and also in the neighbouring ryots' fields and the average yield was thereby considerably reduced in this locality. The occurrence of this pest in such a serious form in a standing crop was rather very unusual in this locality, as it had not been noted till recently as infesting any cereal in the field in this locality. Further it appears it is the first time that this pest is recorded on Ragi on which it has not been recorded before either in the field or in store.

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NOTE ON SOME CHROMOSOME NUMBERS IN GRAMINEAE

THE haploid chromosome numbers of seven genera and ten species belonging to the tribes *Andropogoneae* and *Paniceae* are reported in this note. The young panicles were fixed in propionic alcohol and the fixed anthers squashed in propionocarmine to study the meiosis. The chromosome numbers are tabulated in Table I.

The meiosis in all the species was normal forming regular bivalents except in *Themeda triandra* and *Pennisetum squamulatum*. Assuming the basic number of *T. triandra* to be $x=10$, the plant with $n=40$ should be regarded as an octoploid and should be expected to reveal multivalents during meiosis. Yet it was observed to form usually one quadrivalent and 38 bivalents. *P. squamulatum* with $n=27$, which is a hexaploid of the basic number 9,

TABLE I

Species	Source	Chromosome number n	Previous report 2n	Author
ANDROPOGONEÆ				
<i>Themeda cymbaria</i> Hack.	Ponmudi, Travancore	10		
<i>T. triandra</i> Forsk.	Botanic Gardens, Coimbatore	40	80	Celazier and Harlan, 1954
Do.	Adoni Hills, Kerala State	10	20, 22, 30, 40, 45, 49, 50, 51, 53, 54, 56, 60, 68, 71	Pienaar, 1955
<i>Chrysopogon zeylanicus</i> Thw.	Anamalai Hills, Coimbatore	10	20	Darlington and Wylie, 1955
<i>C. asper</i> Heyn.	Marudamalai Hills, Coimbatore	10		
<i>C. verticellatus</i> Trin.	Siruvani Hills, Coimbatore	10		
<i>Ischæmum petiolare</i> Hack.	Anamalai Hills, Coimbatore	10		
<i>Pseudosorghum fasciculare</i> A. Cam.	Anamalai Hills, Coimbatore	10		
PANICEÆ				
<i>Pennisetum squamulatum</i> Fresen.	Kenya	27		
<i>Panicum maximum</i> Jacq.	Yercaud] Hills, Salem.	18	18, 32, 36, 48	Do.
<i>Stenotaphrum glabrum</i> Trin. (= <i>S. dimidiatum</i> Brongn.)	Travancore	18		

formed one quadrivalent and 25 bivalents during meiosis.

The authors are grateful to the Systematic Botanist and Professor of Botany, Lawley Road, for the supply of live plants of *Themeda triandra*.

Cytogenetics Laboratory, V. S. RAMAN.
Agricultural College and P. CHANDRASEKHARAN.
Research Institute, D. KRISHNASWAMI.

Lawley Road Post,
Coimbatore-3,
September 23, 1958.

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2. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, London, 1955, p. 519.
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PARAFILARIASIS IN BUFFALOES CAUSED BY *PARAFILARIA SAHAI*, N. Sp.

AMONG the skin affections of Indian domestic animals of helminthic origin, those caused by *Parafilaria* Yorke and Maplestone (1926) are widespread. Four species of the genus are already known, viz., *P. multipapillosa* (Condamine and Drouilly, 1878) in equines, *P. bovicola* Tubangui (1934) in cattle, *P. antipini* Rukhliadev

(1947) in deer (*Cervus elephus*) and *P. sp.* Ramanujachari and Alwar (1954) in elephants. These parasites are host specific, and produce in the hosts subcutaneous nodules which come up to the surface, burst, bleed to discharge the larvæ in the oozing blood and the wounds then heal up. The infection among cattle is the commonest occurring throughout the country, specially during the summer months.

Last year, Lt.-Col. P. D. Saksena, Officer-in-charge, Central Military Veterinary Laboratory, Lucknow, reported that a large number of buffaloes at the Military Buffalo Farm, Namkum, Bihar, were suffering from cutaneous bleeding in all parts of the body. In about a week's time where bleeding had taken place, a large abscess formation was seen which in course of time sloughed leaving large sores. The formation of abscess might possibly have been due to secondary infection. No abscess formation has been observed by Alwar and Lalitha (1958) in the case of parafilariasis in a buffalo bull reported by them. It was reported by Lt.-Col. Saksena that on squeezing the abscess, a worm $\frac{1}{4}$ " to $\frac{1}{2}$ " in length was pressed out. One such specimen was received from him in the Division of Parasitology, I.V.R.I., Izatnagar, which on examination was found to be a bit of the anterior portion of a female filarid worm belonging to the genus *Parafilaria*. But it could not be assigned to any of the known species

because of, among other characters, the difference in the cuticular adornment at the anterior end. The roundish cuticular tubercles or papillæ-like structures at the anterior end of this parasite occur in about ten transverse series and extend to a distance of about 50 microns from the anterior extremity. In *P. bovicola* such series of tubercles are far fewer in number and never extend beyond a distance of about 25 microns, though isolated tubercles may occur further back. In *P. antipini* also the roundish tubercles are fewer in number. In *P. multipapillosa* such tubercles occur in 13-15 series and extend to a length of 200-250 microns from the anterior extremity (Metianu, 1949). This parasite also differs from *Parafilaria* sp. from elephant reported by Ramanujachari and Alwar (1954), a photomicrograph of which has been published by Alwar & Lalitha (1958), in the position of the vulva which is, as apparent from the photomicrograph, situated much farther back. The reported occurrence of *P. bovicola* in buffalo as revealed by the presence of similar microfilariae in oozing blood from a cutaneous nodule (Alwar and Lalitha, 1958) needs confirmation by study based on adult parasites. The parasite is therefore assigned tentatively to a new species, *Parafilaria sahaii*, named in honour of Mr. L. Sahai, Animal Husbandry Commissioner with the Government of India, to whom the authors are grateful for much kind encouragement in their researches.

H. D. SRIVASTAVA.
S. C. DUTT.

Division of Parasitology,
Indian Veterinary Research Institute,
Izatnagar, September 20, 1958.

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ON THE OCCURRENCE OF *FIERASFER*
(CUVIER) *HOMEI* AS A COMMENSAL
INSIDE THE BIVALVE, **PTERIA*
LOTORIUM LAMARCK†

THE underwater exploration, by Aqua-lung diving, off the coast of Tuticorin brought to light the existence of the bivalve **Pteria lotorium* in considerable numbers at 14 fathoms depth. This is the first record of the above species in Indian waters. A few of these bivalves were kept under observation in the laboratory. As the shell valves of the animal opened agape, an 'elver' like fish was found writhing inside the mucus mass of the branchial region of each bivalve. The movement of the fish resembled that of a 'pipe-fish'. In shape the fish resembled the Eel or 'conger', but stouter in comparison with its length and also more compressed, the form becoming more slender towards the caudal region. The overall length of the fish was 85 mm. The various morphometric features of the fish and the vertebræ counts taken, after subjecting the fish to "Alizarine" technique agreed on broad points with those of the only fish described by Day (1884) under the Family Ophiidæ although there were minor points of dissimilarity. It is stated by Day that *Fierasfer homei* is the only species recorded in Indian waters occurring as a commensal or 'free-mess-mate' inside the respiratory process of Holothurians. It is quite likely that in the present case also the fish occurs as a commensal inside the bivalve *Pteria lotorium*, preying on organisms entering the shells along with the current or on those which form the 'Epi-fauna' of the bivalve shells which may creep down or wander into the cavity of the shell valves. The fact that all *Pteria* which were brought out from different places were seen to contain one fish of the species above described rules out the possibility of the fish having gone in accidentally.

Marine Biological Station, S. MAHADEVAN.
Tuticorin, October 28, 1958.

1. Day, *Fauna of British India*, 1889, 2.

* I am thankful to Dr. S. T. Satyamurthy, Madras Govt. Museum, for having kindly identified the Bivalve.

† Published with the permission of the Director of Fisheries, Madras.

POINTS FROM LETTERS

Chenopodium and *Lecanthus* as Test Plants for Potato Viruses

Messrs. B. Ganguly and M. L. Khanna, Central Potato Research Institute, Simla, write that while studying for the host range among the prevalent weeds of Simla Hills for different potato viruses, it was observed that *Chenopodium album* Linn. could be infected artificially with potato virus X and *Lecanthus wallichii* Wedd. and *L. wightii* Wedd. with both potato viruses X and A by simple sap inoculation technique with carborundum as an abrasive.

On *C. album* the symptoms of virus X first appear on the lower leaves of the plant after 20 to 25 days of inoculation as very small chlorotic spots surrounded by more pronounced concentric chloritic rings. As the plant grows the concentric rings disappear and the chloritic spots become more pronounced. With the growth of the plant the symptoms extend to the upper leaves and advance gradually up to the apical leaves, while the older infected ones slowly become yellow and wither away. In the case of the plants of *L. wallichii* and *L. wightii* both the potato virus X and A exhibit similar symptoms on these weeds. Faint vein-clearing symptoms first appear on the leaves of these plants after 9 to 12 days of inoculation. As the plant grows the vein-clearing is followed by uniform interveinal mosaic symptoms. Symptoms may be masked with the rise of temperature in all the three cases when the plants act as symptomless carriers for the respective viruses.

Occurrence of *Colasposoma metallicum*, CLK, on Sweet Potato

In the course of investigations on the insect pests of sweet potato crop (*Ipomoea batatas*) the author, Sri. T. R. Subramanian, Division of Entomology, Agricultural College and Research Institute, Coimbatore, noted a heavy incidence of the beetle *Colasposoma metallicum* Clk. (Eumolpidae) on this crop grown in the Central Farm of the Institute, during the months of September and October 1958. This active shiny metallic green beetle measuring about 7.5 mm. in length was seen in large numbers damaging

the leaves of the crop by cutting numerous shot holes on the leaf surface. The damage was severe and the whole crop occupying an area of about an acre was found infested. This insect has been recorded as a pest on sweet potato at Java (Franssen, C. J., Korte. Meded. Inst. Plaziekt, 1934, No. 20, 21; Rev. Appl. Ent., 1935, 23, 264), but has not been so far reported occurring as pest on sweet potato or any other crop in this locality. Incidentally, this insect was also found to damage the plant *Ipomoea carnea* which has been newly introduced as a green manure crop in this tract.

A Teratological Phenomenon in *Annona squamosa* L.

Sri. S. N. Singh, Horticultural Research Institute, Saharanpur, reports that recently, in a seedling of *A. squamosa* L., a pair of sessile leaves were noticed oppositely borne in a stem branch possessing four leaves in all and the leaves of the other branch exhibited normal distichous, alternate phyllotaxy.

The Abnormal branch showed that the petioles of the third and fourth leaf were modified into sheaths and fused together, giving the appearance of two sessile leaves oppositely borne. The growing tip of the branch was subsequently inactivated and remained as a dormant bud in the axil of the two sessile leaves.

Diploid Chromosome Numbers of Two Wild Plants

Sri. S. L. Basak, Department of Agriculture, Calcutta University, reports for the first time the diploid chromosome numbers of *Sida humilis* Willd. and *Justicia gendurossa* Linn. f. as 16 and 28 respectively. *Sida humilis* is a trailing herb in India. Hooker says it is variable. This plant is erect and came from South Africa.

Fruit Rot of *Coccinia indica*

Sri. S. N. Kulkarni (Agricultural Research Institute, Gwalior) reports a fruit rot of *Coccinia indica* caused by *Phythium aphanidermatum* from Gwalior.

REVIEWS

Tauberian Theorems. By H. R. Pitt. (Oxford University Press), 1958. Pp. x + 174. Price Rs. 22-50.

This book, the second in the series of Monographs on Mathematics and Physics of the Tata Institute of Fundamental Research, presents a neat well-motivated account of the theory developed by Hardy, Littlewood and Wiener between 1910 and 1933, out of a hint dropped by Tauber in 1897, and enriched by the author's own contributions since 1938. The book, based mostly on these contributions, is bound to be of interest to a wide class of readers including research workers, as the following chapter-wise summary of its contents may serve to indicate.

Let

$$(*) \quad g(x) = \int_{-\infty}^{\infty} k(x, y) s(y) dy$$

be a convergence-consistent or regular transformation of $s(y)$ into $g(x)$, said to make $s(y)$ summable to a finite value A as $y \rightarrow \infty$ whenever $g(x) \rightarrow A$ as $x \rightarrow \infty$. Then the author's tauberian theorems are assertions about a certain asymptotic behaviour (in particular, convergence) of $g(x)$ being linked to a similar behaviour of $s(y)$, for summability methods with suitable kernels $k(x, y)$ applied to functions $s(y)$ satisfying a condition T which is called tauberian and can assume various special forms. After an introduction and a chapter on 'elementary' tauberian theorems whose proofs do not involve any preliminary transformation of the kernel, the author proceeds, in Chapter III, to generalize the classical tauberian theorems for Riesz, Abel and Borel summabilities, defining these summabilities *via* (*) with kernels of the standard form $k(X)$, $X = x - y$, in the first two cases and a kernel of approximately this form in the last case. The generalizations, obtained by the use (novel in the case of Borel summability) of linear combinations of translations of $k(X)$, are oscillation theorems with conclusions of the form

(***) $S \leq c + CG$,
 $S = \limsup |s(y)|$, $G = \limsup |g(x)|$,
 where c, C are positive constants of which c is arbitrary while C depends on c and the condition T . Chapter IV on Wiener's theory presents, as a basic theorem, one which extends the conclusion (**) to a general summability method defined in terms of (*) with a standard

kernel $k(X)$ whose Fourier transform is non-vanishing. This theorem is shown to have a counterpart for certain approximately standard kernels, and applications are made to various special summability methods. In Chapter V, there are general mercurian results, including Mercer's theorem in integral form and showing that we can solve for $s(x)$ the integro-differential equation

$$g(x) = \int_{-\infty}^{\infty} s(x-y) dk(y).$$

when we restrict $k(y)$ suitably and assume $s(x)$ to satisfy an order condition (as distinct from a tauberian condition) or even no such condition, the solution in certain cases leading to the relation $S \leq CG$ in the notation of (**). The final chapter proves the prime-number theorem, by the tauberian-type Landau-Ikehara theorem, by the classical tauberian theorem for either Lambert or Ingham summability, and by A. Selberg's famous method. It concludes, opening a promising field of inquiry by expressing the idea behind Selberg's proof thus: if

$$g(x) = s(x) + x^{-1} \int_1^x s(x-y) dk(y) \rightarrow 0 \text{ as } x \rightarrow \infty,$$

then $s(x) \rightarrow 0$, provided that $k(y)$ satisfies certain conditions and $s(x)$ certain others expressible in a familiar tauberian form.

Of special relevance to the foot-note to page 92 is a paper by W. Meyer-König and K. Zeller [*Math. Zeit.*, 66 (1956/57), 203-224] not mentioned in the Bibliography. Noticeable defects in typography are broken types, the misprint $x(0)$ for $x(1-0)$ in the first line of page 126, the misprint (3.4.7) for (3.4.8) in line 16 of page 41, and the marginal misalignments of line 18 of page 30 and line 5 from the bottom of page 169.

C. T. RAJAGOPAL.

Behind the Sputniks. By F. J. Krieger. (The Rand Corporation, Public Affairs Press, Washington), 1958. Pp. 377.

The successful launching of Sputnik I by Russia on October 4, 1957 marked the beginning of a new era in the history of man's quest to probe into the fathomless depth of our universe. This was followed by Sputnik II a veritable laboratory with a living individual, weighing nearly a ton. A remarkable victory was scored

by Russian scientists on the eve of the new year 1959 when they shot a rocket into space which escaped earth's gravity and travelled beyond the moon to become the first artificial planet, of the solar system. All these achievements took many a nation engaged in similar pursuits by surprise and this unprecedented human victory has been possible and, indeed is the culmination of painstaking and calculated research programme, to the success of which the early Russian pioneers, among whom particular mention may be made of K. E. Tsiolkovskic, contributed in no small measure.

The book under review is a survey of Russian work in the field of astronautics and the material is presented in the form of 39 articles which are translations from contributions by Russian specialists, concerned with problems of space flight and the associated technical development. The book begins with an introduction in which a brief historical account of Soviet interest in the field of astronautics up-to-date is dealt with. The articles are grouped under the following seven headings :

Space Flight Comes of Age ; Problems of Astronautics ; Biological Factors ; Lunar and Cosmic Projects ; Rocket and Missile Developments ; Satellite Plans and The Sputnik.

A survey of the material presented in the volume is bound to convey even to a layman an intelligent appreciation of this highly complicated subject and how the Russian scientists with their characteristic persistence have solved many of the intricate problems.

Creation of artificial satellites, interplanetary travel and probing the more distant space were thought of as unrealisable dreams. The successes in these fields have been due to the development of suitable engineering materials having exceptional properties, fuels of novel kinds and finally the electronic control systems. The interest in the creation of artificial earth satellites has been stimulated by programmes for the study of the upper air during the International Geophysical Year. Indeed, the day may not be far off when homosapiens could set their foot on planets and possibly return to earth alive.

At the present stage when the world's attention is focussed on the Russian achievements in this field and when the knowledge available is practically next to nothing, the book under review, written in a popular style would be welcomed by one and all.

The Indian Ephemeris and Nautical Almanac for 1959. (Published by the Manager of Publications, Civil Lines, Delhi). 1958. Pp. xxiv + 404. Price Rs. 12-00 or 19 sh.

We had occasion to review* the first issue of this Ephemeris for 1958. The present issue follows generally the same arrangement as the previous one and the few changes introduced, are indicated on p.v of the Preface. In particular, the explanations have been made more exhaustive wherever necessary, and this has made many of the tables more valuable.

We think that it has also been a wise policy not to follow the decision of the several foreign national ephemerides to discontinue publication of the apparent places of the fundamental stars from 1960 onwards, but to restrict oneself to the inclusion of only a small number of important stars. Thus one finds in the present Ephemeris the apparent places of only 68 such stars. It is interesting to find that in the tables relating to mean places of stars, the Sanskrit names are indicated in the footnotes wherever possible, and that 19 out of the 68 stars, whose apparent positions are given, find a place in Indian Astronomy.

Few other minor improvements may also be noted. The two tables relating to conversion of arc to time and *vice versa* have rightly been placed before the table of interpolation coefficients. In the tables which relate to the Indian Calendar, the footnotes to the second table corresponding to each month contain data regarding the moon's entry into the several zodiacal signs, and this is bound to be useful to almanac-makers in the country.

In our review of the first issue, we expressed our disappointment at not finding a single letter of the Sanskrit alphabet anywhere in the whole volume. It is therefore gratifying to note that under the heading of Symbols on p. 402, the names of the Sun, Moon and the Planets are given in Sanskrit, and also in the transliteration of the Sanskrit alphabet Devanagari letters are used.

There is no doubt that this second issue is a definite improvement over the first, and we hope that in future editions more deficiencies will be made good, thus making the Indian Ephemeris and Nautical Almanac a vital factor in the advancement of astronomical studies in India.

B. S. M.

Advances in Petroleum Chemistry and Refining, Vol. I. Edited by Kenneth A. Kobe and John J. McKetta, (Jr.). (Interscience Publishers, New York), 1958. Pp. 641. Price \$13.50.

Crude oil and natural gas have played a major role in the rapid economic progress of the twentieth century. The advances which are being made by the petroleum and petrochemicals industry need authoritative recording. With this aim in view, the editors have, in Vol. I, presented a series of critical evaluations of new developments in this field, contributed by leading authorities. The volume is divided into five sections:—Economics and future trends, Unit operations and Design, Refining processes, Petrochemicals, and Mechanical equipment. Each main section is subdivided into chapters to provide some perspective and a better understanding of the size and structure of this growing industry.

Section I deals with the complexity and problems involved in the basic operations of exploration and production of oil and natural gas and the trends of expansion in petroleum industry, in the United States in particular. Section II deals with improved separation processes coupled with the nearly untouched potentialities of crystallization and their results. It also gives an account of special features in the design of an extractive-distillation column and discusses the comparative merits of various types of New Fractionating-tray Designs. Section III discusses the need for modifying the refinery operations to provide the fuel for future engines and gives an account of catalytic reforming and solvent refining. Section IV deals with information regarding Oxo-operation and Oxo-plants of which there are currently five in operation in the United States. The principal commercial use of Oxo-process in U.S. is to make C_8 and C_{10} isomeric alcohols. This section also explains the production of solid polymers with specific molecular structure as a result of the development of new surface catalysts. In Section V, an attempt has been made to forecast the trends in new power plant developments and to evaluate the evolving changes in the older types. At no time in automotive history has there been such wide exploration of new ideas for power production. Hence in this section there is a major emphasis on the trends in automotive power plants utilising petroleum products for fuels and lubricants.

The book gives a connected account of recent advances of petroleum chemistry, refining and critically evaluates the future possible industrial developments in the science of petroleum.

It has taken the fundamental knowledge of chemistry and chemical engineering and transformed itself from a simple processing industry for fuels and lubricants to an extremely complex chemical process industry. This edition is very well brought out and the editors deserve to be congratulated in their choice of leading authorities as contributors, with the signal purpose of popularising a complex and dynamic industry, such as petroleum.

S. BALAKRISHNA.

Drycleaning: Technology and Theory, A Report of the National Institute of Drycleaning. By Albert R. Martin and George P. Fulton. (Interscience Publishers, Inc., New York), 1958. Pp. viii + 269. Price \$6.00.

This monograph presents an up-to-date survey of our knowledge of the field of detergency, both aqueous and non-aqueous. It is set out in twelve chapters, the first of which describes very briefly drycleaning fluids, solvent reclamation, equipment used, drycleaning detergents and the colossal volume of drycleaning sales which was estimated at \$1,750 million for the year 1956. The second chapter which deals with the soiling of fabrics presents a concise account of various types of natural soils derived from various sources along with their chemical compositions, particle sizes and physical and chemical characteristics. The considerations governing the formulation of a model artificial soil as well as its application to fabrics and the methods of measurement of the degree of soiling are also expounded in this chapter. The succeeding four chapters deal respectively with the detergent process in aqueous systems, the mechanism of soil removal in drycleaning, and selection of drycleaning solvents. Chapters VI and VII discuss the merits of the various types of drycleaning detergents based on soap and the synthetic drycleaning detergents, along with methods for their evaluation. The colloid chemistry of non-aqueous solutions, formation of micelles in non-aqueous solutions, the important role played by water in the drycleaning bath, the practical application of the electrical conductivity data are all discussed in Chapters VIII, IX and X respectively. The last two chapters present the scientific basis of garment finishing and the physical effects related to finishing. These include a resume of the theories regarding the effect of water as well as of heat on textiles, the mechanical properties of textiles, creasing, wrinkling and shrinkage as

well as other physical changes in garments caused by improper finishing (pressing).

While this book cannot be considered to be a manual of drycleaning, it fulfils admirably its avowed object, namely, to assist all technologists engaged in researches in the field of detergency. The book cites copious references which are well indexed. The printing and get-up are excellent.

K. R. K.

General and Inorganic Chemistry. Third Edition. By J. R. Partington. (Macmillan & Co., Ltd., St. Martin's Street, London W.C. 1), 1958. Pp. xxiv + 927. Price 60 sh.

Brought out in excellent print and with very good diagrams, Professor Partington has once again given to students of Chemistry another edition of his popular book. A large amount of new matter has been introduced in this edition, which very clearly stress the fields of research activity going on in chemistry. While treating the hydrides of boron the author has given a very brief and useful description of the now commercially manufactured materials, the metallic borohydrides. The alkyl diboranes and the boranes have also been described. The much needed inclusion of the chemistry of the rare earths is to be greatly appreciated. The author has unfortunately not given the necessary prominence, in this section, to the "lanthanide contraction" (p. 436-I) and treating the chemistry from this principle which is undoubtedly 'one of great importance in the increase of our knowledge of the connection between atomic structure and the properties of elements'. Also, whatever pleas Professor Partington may give regarding the plan of his book, the reviewer feels that the "Inert Gases" certainly deserve a separate chapter to themselves.

In the highly condensed 'General Chemistry' part of the book the author with great dexterity has introduced the very important facts pertaining to the "packing fraction", also the paragraphs on Nuclear Chemistry have been largely increased and extended, and these have given the sections of "Radio-activity" and "Isotopes a completeness.

Apart from the 927 pages in conformity with the pagination in the previous edition, about 70 pages of entirely new and latest material have been incorporated in the body of the book. They deal with our further knowledge regarding Francium, Boron Hydrides, Rare Earths, Photosynthesis, Thorium, Nitronium compounds, Niobium, Tantalum, Polythionates and Sulphur

nitrides, Technetium, Polonium, Transuranic Elements, Structure of Metal Carbonyls and the theories of metals and of complex ions.

Regarding the 'impurities' or 'abnormal states' attributed to diamond in discussing its structure (p. 440), the reader is, however, strongly recommended to refer to the proceedings on the Symposium on Diamond published in the *Proc. Ind. Acad. Sci.* 1944, 19 A, 189-432. It is felt that the disposition of Fig. 25 (p. 49) illustrating Perrin's experiment on Brownian movement is not according to convention and is likely to mislead the unwary student.

A reading of this book will give a student the much-desired highly co-ordinated picture of the subject and many of the references provide very good and simple introduction to research papers. It will serve as an ideal text-book for the 3-year degree course now introduced in the Indian Universities.

G. B.

Scientific Glass Blowing. By E. L. Wheeler. (Interscience Pub., New York), 1958. Pp. xxii + 478. Price \$ 9.75.

The variegated experience of the author in the field of glass blowing and in general laboratory practice has impelled him to present the subject-matter under review from a new standpoint.

Simple operations in glass blowing are described in the beginning with numerous illustrative diagrams. A vast field in scientific glass blowing including the manufacture of many precision and complicated apparatus are described in an easy-to-follow way. In addition to this, the author has devoted a good portion of the book in presenting various other laboratory techniques such as lathe work, coating of glass and metal surfaces with thin metal films, vacuum technique, purification of mercury, etc. A good knowledge of these techniques will be very useful to glass blowers particularly to those who are attached to research organisations.

Making ground glass joints—glass-to-glass joints and glass-to-metal joints—is indeed one of the major items of work a laboratory glass blower has to handle. A lengthy chapter is devoted to the description of the various steps and procedure involved in the manufacture of these. Ample illustrative diagrams and photographs of tools and machines used in different operations make the book interesting.

Tables and many other useful information given at the end of the book will come in very handy for reference.

The simplicity of approach adopted makes the utility of the work still greater, as even a beginner will find the complexities explained in a manner understandable to him. The reviewer would unhesitatingly recommend this book to every laboratory technician and research worker who have to deal with glass apparatus.

K. T. BALAKRISHNAN.

Animal Disease and Human Health. (*Annals of the New York Academy of Sciences*, Vol. 70, Art. 3, June 1958. Pp. 277-762.

Like every one of the annals of the Academy this volume of about 500 pages is authoritative. In eight parts are found the various papers presented at a Conference on Animal Disease and Human Health organised by the New York Academy of Sciences in collaboration with the Communicable Diseases Centre, Public Health Service, during September 1957.

A general idea of the problem can be had by reading Martin's Introduction in the beginning and Schuman's Summary at the end of the Volume.

To us, in India, the chances of human beings acquiring diseases from their animal contacts are really much more on account of the generally bad environmental conditions and the greater intimacy between man and animal, especially cattle. The Arthropod-borne Encephalitides are only now being studied though in a small way in India. The Kyasanur Forest Disease, a febrile disease with hemorrhagic complications has recently arrested the attention of the Indian Council of Medical Research. But there are no data regarding the large number of sporadic cases of Encephalitis seen all over the country.

Rabies has been discussed in Part IV. The prevalence of the infection in bats, the development of chicken embryo vaccine and the possibility of inducing passive immunity by injections of hyperimmune anti-rabies serum should interest all Indian workers. Undoubtedly the extent of the rabies problem in India is much more than in the United States.

Salmonellosis is apparently on the increase in India and requires more intense study.

Physicians and veterinarians will alike be interested in this extremely informative book. The problems connected with Animal Disease and Human Health in India are in many ways different from what they are in the U.S.A. It will be most interesting and useful if the Indian Council of Medical Research can organise a conference similar to the one which forms the

basis of this volume and focus the attention of Indian workers on local issues.

K. S. S.

Books Received

Cytology and Cytogenetics. By Carl P. Swanson. (MacMillan & Co., St. Martin's Street, London W.C. 2), 1958. Pp. x + 276. Price Rs. 7-50.

Principles of Statistical Techniques. By P. G. Moore. (Cambridge University Press, London N.W. 1), 1958. Pp. viii + 239. Price 22 sh. 6 d.

The British Journal of Psychology—Figural After-Effects. By Peter McEwen. (Cambridge University Press, London N.W. 1), 1958. Pp. vii + 106. Price 22 sh. 6 d.

Advances in Clinical Chemistry, Vol. 1. Edited by H. Sobotka, C. P. Stewart. (Academic Press, New York-1; India: Asia Publishing House, Bombay-1). 1958. Pp. xi + 308. Price \$ 12.00.

A Periodic Table for Fundamental Particles. By J. J. Grebe, (*Annals of the New York Academy of Sciences*, Vol. 76, Art. 1), 1958. Pp. 1-16. Price not given.

The Influence of Sulphydryl Groups and Their Inhibitors on the Distribution of Radiocobalt in the Organs and Intracellular Organelles of the Mouse By L. S. Maynard. (*Annals of the New York Academy of Sciences*, Vol. 72, Art. 6), 1958. Pp. 227-238.

Hodgkin's Disease. By A. Rottino and others. (*Annals of the New York Academy of Sciences*, Vol. 73, Art. 1.) Pp. 1-380.

Surgical Convalescence. By F. C. Dohan and others. (*Annals of the New York Academy of Sciences*, Vol. 73, Art. 2.) Pp. 381-538.

Phosphorus and its Compounds, Vol. 1. By J. R. Van Wazer. (Interscience Publishers, New York), 1958. Pp. xiii + 954. Price \$ 27.50.

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The Basic and Clinical Research of the New Antibiotic, Kanamycin. By Maxwell Finland. (*Annals of the New York Academy of Sciences*, Vol. 76.) Pp. 17-408.

SCIENCE NOTES AND NEWS

Award of Research Degrees

The Andhra University has awarded the D.Sc. Degree in Mathematical Physics to Sri. I. V. V. Raghavacharyulu for his thesis entitled "Representations of Space Groups", and D.Sc. Degree in Physics to Messrs. S. Paddi Reddy and I. Achyuta Rao for their theses entitled "Studies in the Electronic Spectra of Certain Diatomic Molecules" and "Spectroscopic Investigations on some Disubstituted Benzenes and Carbonate Compounds" respectively.

The University of Poona has awarded the Ph.D. Degree in Physical Chemistry to Sri. D. N. Sitharamarao for his thesis entitled "Diffusion of Ions in Solution".

Application of Atomic Energy to Agriculture (Radio-isotopes and Grants-in-aid available)

In order to promote the application of atomic energy to food and agriculture, the Department of Atomic Energy will supply radio-isotopes and other equipment to scientific workers in universities and other institutions. Grants-in-aid will also be available for those engaged in investigating the use of atomic energy in agriculture, food processing, animal husbandry, fishery, forestry, and allied subjects.

All applications in this connection would be preferred to a ten-member Advisory Committee presided over by Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi. This Committee, besides advising the Department on the subject of grants-in-aid and supply of radio-isotopes and other equipment, would also encourage and advise research institutions, universities and other organisations in the use of atomic energy in agriculture and food processing.

Besides the Chairman, the Committee consists of the following members: Dr. A. R. Gopal-Ayengar, Sri. B. K. Chougule, Dr. E. K. Janaki Ammal, Dr. V. N. Patwardhan, Dr. S. V. Pingale, Dr. S. Pradhan, Sri. A. S. Rao, Dr. M. S. Swaminathan, and Dr. K. C. Bora, Atomic Energy Establishment, Member-Secretary.—(Press information Bureau, Govt. of India, Bombay).

TheACHEMA 1961, 13th Exhibition Congress

The above Exhibition Congress of Chemical Engineering organised by the DECHEMA will be held in Frankfurt a.M. from 9th to 17th June 1961. It will once again include the follow-

ing groups of exhibits: Research and literature, New chemical substances, Nuclear science and techniques, Laboratory techniques, Measurement control and automation techniques, Structural materials techniques, Works techniques, Pumps and fittings, Packing techniques, Auxiliary materials and consumable stores, Accident prevention and works safety precautions.

International CIB Congress 1959, Rotterdam, 21-25 Sept.

On the occasion of its third General Assembly in 1959 the International Council for Building Research, Studies and Documentation, C.I.B., will organise an international congress open to C.I.B. members and their representatives, as well as to other interested experts.

The principal object of the congress will be to widen the horizon of experts by presenting to them important building research and building documentation problems and results. The subjects will be introduced by leading experts from various countries and subsequently put up for discussion. The subjects relate to theoretical and applied building research and to building documentation and transmission of knowledge. In addition, attention will be given to some special aspects of building in tropical countries.

The congress subjects will be introduced in plenary sessions, and will be continued, if necessary, in parallel sessions. During the plenary sessions of the congress simultaneous translations of the proceedings into English, French and Russian will be arranged.

Provisional application forms are to be completed and sent before 15th April 1959 and can be had from Assistant Director (Information), Central Building Research Institute, Roorkee.

Hydraulics Research Papers

The Hydraulics Research Station, D.S.I.R. is introducing a new series of research papers. The first two (Resistance of fluids flowing in channels and pipes, price 8 sh. 6 d., and Charts for the hydraulic design of channels and pipes, price 12 sh.) deal with the flow of water in open channels and pipes, and it is hoped that design engineers will find them a valuable reference work.

During the past 200 years the flow of water in channels has been studied extensively and

a large number of formulae has become available to the design engineer. However, as these formulae are generally of limited application, designers have experienced difficulty in selecting formulae appropriate to their requirements and much confusion has been caused. In the 1930's, Dr. Colebrook and Professor White working at Imperial College, London, employed the then new theories of turbulence to bring almost all the problems of hydraulic friction within the scope of one equation. This equation is recognized as the best yet devised but unfortunately it has proved to be too complex to be popular with the average design engineer. Attempts have been made in several countries to express it in easily usable form but none was completely successful.

The Hydraulic Research Station has now solved the difficulty by developing the formula so that it can be expressed in graphical form. Paper No. 1 gives this development after fully reviewing and discussing the subject of hydraulic friction. Paper No. 2 contains 28 design charts, based on this development of the Colebrook-White formula, covering a wide range of conditions, materials of construction and cross-sectional shapes for conduits ranging from 80-ft. diameter hydro-power tunnels down to one-inch diameter copper piping. Many examples of hydraulic designs are given in this publication, including an oil pipe line, concrete-lined channels of rectangular and trapezoidal cross sections and storm drains flowing with a free water surface.

Image Intensification of X-Radiograms by Television

A problem whose solution will be of great interest to radiologists is how to obtain image intensification of X-ray radiograms with a reduced dosage of X-radiation. In diagnostic radiology an X-ray image is usually rendered visible by a fluorescent screen when X-ray energy is converted into light energy (or by a photographic film which, on processing, reveals the latent image). The present method of image intensification is to convert this light image on the fluorescent screen into an electron image. The energy of the electrons is then increased and the image may be focussed with electron lenses and allowed to fall on another fluorescent screen yielding a considerably brighter image than the first one. Alternatively the initial image may be scanned as in television, the resultant electric current being then amplified and viewed on a conventional television screen as an image with increased

brightness. The radiologists, however, is primarily concerned with obtaining a brighter image with less radiation and without significant reduction of definition rather than with achieving merely increased brightness with the same doses of radiation as are used with conventional methods. There are many reasons for wishing to reduce the dose of radiation, the potential hazards being in themselves a cogent one. It seems unlikely that further advances of major importance can be made in this field unless a more efficient means than the fluorescent screen is found for converting the primary X-ray image, for, though image intensifiers may have an intensification factor of hundreds the radiologists can reduce the dose of radiation only by units, if definition is not to be sacrificed. —*British Medical Journal*, December 13, 1958.

Flurotron Camera Reduces X-Ray Exposure Time

Although early stages of a number of serious illnesses can be diagnosed by X-Ray, many people had been reluctant to submit to such examination because of the fear of radiation exposure. Beattie-Coleman's new Flurotron Camera answers the need for a camera lens fast enough to accomplish the desired reduction in radiation hazard.

The Flurotron Camera has an $f/0.95$ image-flattening lens which reduces X-Ray exposure time to about 40% of that previously required, with improved lens resolution which contributes significantly to diagnostic accuracy. The camera is electrical; pulse-operated; powered by 110-120 V., 50-60 cycle AC; designed specifically for fluorographic recording. The $f/0.95$ lens is refractive; nine element; 120 mm. The fully automatic magazine accepts up to 100 feet 70 mm. roll film.

Further details are available from Ad. Auriema, Inc., 85 Broad Street, New York 4, N.Y., U.S.A.

Household Warning Alarm for Nuclear Fall Out

Tracerlab, Inc., Waltham, Mass., has recently developed a practical, dependable, inexpensive device which can provide every American Family with its own nuclear fall out warning alarm. After alerting the household to dangerous radiation fall out, the device can guide the family to safety.

The new device called the BANSHEE, plugs into any standard radio, or television set and sounds a wailing alarm through the loud speaker when exposed to radioactive fall out in dangerous concentrations.

The 'brain' of the Banshee is about the size of the eraser on a standard wooden pencil and is made of inexpensive components. The device operates only in response to radiation. In AC sets, it will operate as long as power is available. Its full utility is realised however in a battery operated set with an independent power supply which makes it portable. Since it draws no current in the standby condition, it does not drain the batteries.

One of the most important aspects of the device is that with auto or portable home radios it can act as a path-finder to lead survivors out of radiation danger areas. The pitch of the wail rises as the amount of radioactivity increases, and falls as the amount of radiation decreases. By travelling in the direction which causes the pitch of the wail from his portable or automobile radio to fall, a person can escape from a radiation danger zone.

The first working model was successfully demonstrated to Commissioner Willard Libby of the U.S. Atomic Energy Commission in December 1958, who gave his reaction thus: "I am very excited about the possibility of Banshee as a nuclear fall out monitor. I have long urged that such a monitor be made available, and Tracerlab's achievement proceeds in the direction I have outlined on many occasions heretofore". —Tracerlab: *News Release*.

Argon Chromatograph

This Pye Chromatograph which uses the new Argon Detector of the ionization type devised by J. E. Lovelock shows one of the recent advances in gas chromatography technique. Argon which is used as the carrier gas is excited into its metastable state on entering the Detector. The excitation energy of argon is 11.6 volts and as this level is higher than the ionization potential of organic vapours, any organic vapours present in the carrier gas are ionized on collision with excited atoms as they enter the Detectors thus causing a considerable increase in current through the cell. Furthermore, the electrons emitted when organic vapour molecules are ionized, are able to enter into the process of producing more metastable or excited argon atoms. Such an effect depends upon cell voltage so that with an increase in voltage greater sensitivities are obtainable. The sensitivity range is approximately one part component in 2×10^6 to 2×10^3 parts of carrier gas for full scale deflection on the recorder. The limit of detection is one part component in 2×10^8 of carrier gas of 10^{-11} moles. Minute samples in the order of 0.1 to 0.025 microlitre

are inserted quite simply by a micropipette. No overloading occurs since a smaller proportion of liquid phase is used: as a result column efficiencies in the order of 1000 theoretical plates per foot length of column are obtainable. A short, high efficiency column gives a much reduced analysis time and increased definition. (Physical Society; 43rd Exhibition of Scientific Instruments.)

Filter-paper Method of Measuring Flocculation of Suspensions

Prof. R. Fahraeus of Germany, has developed a method for measuring the degree of coagulation present in a blood sample. The procedure is to filter the blood through a stack of filter-papers and to measure the quantity retained on each. This technique has been tried by R. L. Whitmore (*Nature*, January 31, 1959) for measuring the degree of flocculation of shale and clay suspensions. 100 ml. of a 2% suspension (by weight) of a coal-measure shale in distilled water is poured into a pressure filter which contains a stack of filter-papers (Whatman No. 4, 9 cm. diam.) and a pressure of about 15 lb./sq. in. is applied. The experiment is repeated with the suspension after 5 ml. of a 1% solution of potash alum has been added to it in order to produce flocculation of the solid matter. The reduction in the penetration of the filter-papers becomes very obvious. Comparative study of the contents of successive filter-papers should make the method amenable to quantitative measurement.

Maser Technique in Radio Astronomy

L. E. Alsop *et al.* report (*Astron. J.*, 1958, 63, 301) the successful application of maser techniques in radio-astronomical observations at the U.S. Naval Research Laboratory. The maser amplifier is a three-level Bloembergen type (see *Curr. Sci.*, 1958, 27, 119) with a 0.1% concentration of Cr^{3+} in ruby serving as the paramagnetic medium. The ruby crystal is mounted in a double resonant microwave cavity in liquid helium at 1.4°K . and in a magnetic field of 3500 oersteds. The optimum signal-to-noise ratio for the system is obtained with a gain of about 20 decibels. The maser is used as a pre-amplifier and is mounted near the focal point of the 50 ft. reflector. The results obtained show an improvement factor of ten in signal-to-noise ratio over the same installation without the maser pre-amplifier. Observations were made of Venus, Jupiter and Nebula NGC 4486.

Synthetic Quartz Crystals

The Western Electric Company and the Bell Telephone Laboratories in New York have jointly succeeded in growing large crystals of artificial quartz. It has long been known that small quartz crystals can be developed in silicate solutions by suitable treatment, but in the new process crystals up to 5-6" long and 2-3" cross-section have been obtained. A vertical autoclave is filled with a solution of sodium hydroxide and small pieces of natural quartz are placed in the bottom to serve as material. Seed plates cut from natural quartz crystals are hung from a rack in the upper part of the vessel. After sealing, the autoclave is adjusted to satisfy the severe conditions of temperature and pressure required for the process. A constant temperature differential is maintained from bottom to top during the processing time which may last several weeks. The nutrient material dissolves in the hotter lower region and is carried by convection currents to the cooler upper region, where the solution becomes supersaturated and the dissolved silica is deposited in the form of a single crystal. The crystals produced are free from foreign inclusions, are without optical or electrical twinning and can be sawn in the most efficient manner.—*Nature*, January 31, 1959.

Researches on Synthetic Rubber

Details of research carried out at the Max-Planck Institute for Coal Research, Mulheim-on-Ruhr, on the use of metallic alkyls in the production of a new type of synthetic rubber were given recently by Prof. Karl Ziegler, at a conference of the German Society for Mineral Oil and Coal Chemistry at Goslar.

Organo-metallic compounds, particularly aluminium compounds, were used as a basis for the experiments. The research was initially concerned with the synthesis of aluminium trialkyl from aluminium, hydrogen and olefins, and with the various uses to which such a product could be put. The alkyls could be used either for catalysing purposes or as auxiliary agents in the production of extra-active organometallic co-catalysts. With the aluminium alkyls, olefins, particularly ethylene, in the low-mole-

cular field could be polymerised. This meant that using ethylene, butylene, hexene, octene, etc., or with propylene or isohexene, a most varied range of materials could be produced.

By the addition to such chemicals as listed above of the aluminium alkyls and titanium compounds it was possible to effect a favourable physical development into the high-molecular range, which made possible the production of any number of quite different types of product. Reaction with catalysts such as the above yielded products such as low-pressure polythene, polypropylene, various types of butadiene-rubber and so on. A catalyst agent of this type had already outside Mulheim, been able to produce what was called 'synthetic natural-rubber' from isoprene. Another organometallic co-catalyst had been found to convert butadiene under cyclic trimerisation into cyclododecatene, a basis for many interesting new compounds, particularly in the field of Perlon-type materials.

The intermediate products were the organo-aluminium compounds used for the production of higher-quality fatty alcohols from ethylene, organic borax compounds and of tetra-ethyl lead (the best known anti-knock medium for motor engines).—*Chemical Age*, December 6, 1958.

Thickness of Earth's Crust in Antarctica

Antarctica has always been regarded as a continent. A direct method of verifying the continental status of Antarctica is to determine the thickness of its crust, for it is fairly well established that the continental regions have a crustal thickness of 30-40 km. or more, in contrast to thicknesses of 5-15 km. in oceanic regions.

Under the Antarctica Programme of the IGY, the three seismographic stations, Hallet Station (U.S.A.—N.Z.), Scott Base (N.Z.) and Mirny (U.S.S.R.) obtained seismic wave records of the earthquake of September 9, 1957 with epicentre in the South-East Indian Ocean (48° S, 101° E). An analysis of the records has shown that the thickness of the crust in Eastern Antarctica is about 35 km. This confirms the existence of a true Antarctic continent.—*Nature*, January 31, 1959.

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POLAROGRAPHY*

WHEN nearly 40 years ago Heyrovsky for the first time used the dropping mercury electrode to study electrolytic processes, few could foresee that a versatile analytical technique and an entire science with great potentialities would grow out of it. Today the science of polarography, originally regarded as a narrow branch of electrochemistry, has spread across the fields of industry, biology and medicine, and there is a voluminous literature on the subject comprising literally of tens of thousands of journal articles besides quite a few monographs and standard text-books. The book under review alone contains more than 800 pages and more than 2,000 references.

What is polarography? It is the technique of investigating cathodic phenomena during electrolysis of solutions, and is essentially based on the study of the current-potential curves obtained by using a dropping mercury electrode. It is well known that the use of solid metal electrodes such as platinum, lead, etc., has the disadvantage that the surfaces change during the process, due to deposition or chemical reaction with the products of electrolysis, and as such the results are not reproducible and their interpretation consequently becomes difficult and dubious. The dropping mercury electrode, which is the basis of the success of the polarographic method, consists of a very fine bore (0.04-0.08 mm.) capillary glass tube connected by a flexible tube to an adjustable mercury reservoir. Mercury flows through the tube and tiny drops of mercury are formed (every 2-5 seconds) beneath the surface of the electrolytic solution kept in one of the limbs of the, usually, H-shaped polarographic cell. The anode or the reference electrode is a layer of mercury of large area at the bottom of the other limb. As the applied voltage between the electrodes is increased, electrolysis proceeds on the dropping electrode and the current (of the order of microamps) through the cell is measured with a sensitive galvanometer. In the polarograph devised by Heyrovsky and Shikata, automatic recording of the current-voltage curves is obtained. These curves known as the polarographic curves containing characteristic 'waves' enable one to establish qualitatively and quantitatively the substances which are

present in the solution. The value of the potential at which the wave is formed identifies the substances and the height of the wave gives the amount of the substance present in the solution.

The chief advantages of polarographic analysis are (1) it is possible to determine several constituents simultaneously, (2) 0.5 ml. of the solution to be investigated is sufficient and the limits of determination are between 10^{-5} and 10^{-6} M solutions. (3) The polarographic recording takes only 2-8 minutes and on the average a dozen samples can be analyzed per hour. (The time for the preparation of the solution depends on the kind and complexity of the sample, and generally it takes several minutes to one hour.) (4) the method provides a permanent record of the analysis.

The book under review, *Polarography in Medicine, Biochemistry and Pharmacy*, although it is based on the Czech edition of 1952, is not a mere English translation of it but a completely revised and enlarged edition. The new literature, that has accumulated in the intervening years, has necessitated the rewriting of more than half the Czech text. The contributions from Prof. Brdicka and his school have played an important part in this field. The volume comprises of eight parts, each divided into appropriate chapters dealing systematically with the polarographic analysis of related groups of substances.

After a very brief Introductory Chapter which forms Part I of the book, Part II deals with the polarographic determination of inorganic compounds, metal-wise, in different substances, in the organs of the body and in their secretions. Part III, which forms the major bulk of the book, covering as it does about 400 pages, deals with the determination of organic compounds under Quinones, Redox systems, Halogen derivatives, Aldehydes, Ketones, Sugars, Nitrogen compounds, Alkaloids, Vitamins, Hormones, etc. Parts IV and V deal respectively with Proteins and Enzymes. Part VI deals with the analytical applications of Polarographic Maxima. Part VII gives a Table of important Buffers followed by Tables of Half-wave Potentials for ready reference. The Final Part gives the Bibliography, Index of Materials and subject index.

The book is amply illustrated and almost every other page contains the actual polarographic curve for the substance studied. Polarographic cells to be used in special cases

* *Polarography in Medicine, Biochemistry and Pharmacy*, by M. Brezina and P. Zuman. (Interscience Pub., New York.) Pp. xviii + 862. Price \$ 19.50.

are also illustrated and described. The book is written in considerable detail so that a polarographer working in the laboratory, or the hospital or in the pharmacy can carry out the analyses without any further reference to the original work. It is indeed an exhaustive laboratory manual which one working in the field could hardly afford to miss. Further, as no single book of comparable quality is available in English, the present edition will bring the subject of Polarography in Medicine and in Biochemistry nearer to a greater number of workers in the field and stimulate further research in this direction.

This English edition, with its excellent printing and get-up, coming as it does on the eve of his 70th birthday, can be regarded as a tribute to the author of Polarography, Academician Jeroslav Heyrovsky. Prof. Heyrovsky not only discovered the polarographic method but also was able to develop it to the full extent of its practical and theoretical application and to set up a school that would continue the development of polarography in the years to come.

The Polarographic Institute at Prague, of which Prof. Heyrovsky is the Director, since its founding in 1950, has been extending polarographic studies into new vistas. The poten-

tialities of employing the oscillograph for the study of electrode reactions proceeding on a single drop of mercury are being examined and Prof. Heyrovsky has succeeded in developing the "Polaroskop" based on oscillographic polarography wherein the presence of reducible or oxidizable substances is signalled by cuts appearing on the oscillographic curves. The depth of the cut indicates the amount of the substance contained in the solution while its position enables one to identify the substance. Another new investigation in oscillographic method in which Prof. Heyrovsky has been working is the "Impulse polarography". In this method polarographic curves are obtained by the application of voltage impulses, and the duration of study will be a matter of few seconds only.

The forthcoming Second International Congress of Polarography to be held in Cambridge in August of this year will focus attention on the recent achievements of Polarography and its applications in Fundamental studies, in Industry and in Biology and Medicine.

India recognized the outstanding importance of the work of Prof. Heyrovsky when the Indian Academy of Sciences elected him as an Honorary Fellow at its last meeting.

MINIATURE GENERATOR POWERED BY RADIOISOTOPES

THE U.S. Atomic Energy Commission, under its project for constructive uses of atomic energy, has developed a miniature Atomic Generator known as the "Radioisotope—fuelled thermo-electric generator". In this device the heat continuously given out by a radioisotope is converted into electricity by use of special semiconductors which act as thermo-couple materials causing flow of current under differential temperature conditions.

The cylindrical generator is $4\frac{1}{2}$ inches wide and $5\frac{1}{2}$ inches high, weighs only 5 lb. and has no moving parts. It is capable of generating five watts of electricity from a 3,000 curie source of Polonium-210. The tiny pellet of fuel is in the centre of the device and is surrounded by 20 pairs of thermo-couples radiating like the spokes of a wheel. The polonium capsule heats itself to more than 700° F. by the energy of disintegration (5.3 Mev., alpha particles). The double-layered spokes are composed of the thermo-electrical material lead telluride that is alloyed with other substances, including bismuth and manganese. Doped semiconductors with their poor heat transmission characteristics

have revolutionized the field of old bimetal thermo-couples. When the ends near the source get heated by the continuously radioactive isotope, electric current is set up in each of the thermo-electric spoke and is collected at the rim into a central outlet.

Polonium-210, of half-life 138 days, used as fuel in the model is particularly expensive. But it is intended that later models will use longer lasting and less expensive radioisotopes. One of these is Cerium-144 whose half-life is 290 days, which, if used as fuel, would turn out more power for a longer period of time. Eventually use could be made of radioactive atomic materials now regarded as waste. The weight of the generator could also be reduced to about 3 lb.

The Generator has great potential use as power sources for instruments carried in satellites and space probes on account of its compactness, efficiency and long life. The conventional batteries in the U.S. Atlas satellite [see *Curr. Sci.*, 27 (12), 480] weighed 20 lb. and lasted only for 18 days.—*Atoms for peace Digest*.

BOREHOLE IN THE OCEAN BED

AT the meeting of the International Union of Geodesy and Geophysics held in Toronto in September 1957, plans were made for drilling a deep borehole into the rocks below the earth's crust. The object is to get direct information about the contents, composition, physical state, etc., of the upper mantle of the earth. The mantle itself extends to about half way to the centre of the earth and encloses a core which, the results of seismic wave observations indicate to be fluid and is believed to have a nickel-iron composition.

Our present knowledge of the earth's upper mantle is largely based on reasonable extrapolation carried downwards of the results of detailed surface studies, geological and geophysical, of the earth's crust. Recent observations, however, especially on temperatures and heat losses at great depths have thrown doubts on some of these extrapolated findings thus necessitating by more direct means, if possible, a fuller understanding, of the sub-crustal material. It is thought that the sub-crustal material is in a crystalline rather than liquid state and the facts of isostasy show that despite the solid condition of the mantle, it must be capable of flowing under sustained stress.

The crust itself is extremely heterogeneous and complex and it is to be expected that with increasing depth there will be increasing homogeneity in composition and increasing simplicity in the phenomena leading to it. The borehole method will help to get the history of the earth's crust from the very beginning for it will lead to the study of the crust from the interior upwards.

The region of demarcation between the mantle and the crust is the Mohorovicic discontinuity, known as the Moho, which is more or less well established on account of its showing a well-defined break in physical properties of the materials on either side of it. The existence of this discontinuity is obtained from knowledge of the velocity of the compressional earthquake waves which show a sudden jump from about 21,000 ft./sec. on the one side to about 27,000 ft./sec. on the other. In the rocks above the Moho the seismic wave velocity increases downwards from 4 to 6.7 km./sec. which is explained as due to the variable composition of the rocks. On the other hand, below the Moho, that is on the uppermost part of the mantle, the velocity is surprisingly constant at 8.1 km./sec. showing that the sub-crustal rock is fairly uniform in composition. The Moho

is about 20 miles (35 km.) below the surface under the continents, but may be as close as 2 to 3 miles (4-5 km.) under the deepest ocean floor. The layer below the Moho does not come to the surface and therefore it is necessary to drill to find out unambiguously the nature, chemical composition, radioactivity, etc., of the material that forms the earth's mantle—at least the fringe of it.

According to *Science Newsletter* plans to bore a hole 3 miles deep in the ocean floor have been made by a special committee of the National Academy of Sciences—NRC. The idea is to drill down through all the layers of sediment covering the ocean floor and obtain samples all the way down and from below the Mohorovicic discontinuity. The overall properties of material through which the drill hole would pass could be measured to great advantage. For example, data on temperature gradient and conductivity would lead to a better understanding of heat flow in the interior of the earth. The magnetic properties of the samples at different depths would throw more light on the magnetic anomalies at sea and also explain the remnant magnetism of the rock samples and problems connected with palaeomagnetism.

Analysis of samples in the 1,500 ft. deep soft sedimentary column below the ocean bed would elucidate the depositional processes that have been going on in the past. A complete picture of the sedimentary column might also show the appearance of the first life in the sea and perhaps a clue to its origin. There might be unexpected discoveries also in this probing adventure into such new and unexplored territory as a hole miles deep in the ocean floor.

Difficulties of boring a hole to the earth's mantle under the ocean floor are indeed great. It is to the oil industry that we owe most of the recent developments that have taken place in drilling. The deepest hole so far drilled on *terra-firma* is over 4 miles. For underwater boreholes, the drilling will have to be done from floating vessels which again brings up new problems to be faced. Techniques already afoot for underwater rock sampling, off the California coast may help in the development of methods to meet the new requirements. In one of the Californian offshore trials a 300 ft. hole was drilled in a depth of 600 ft. of water. But drilling a 10,000 ft. hole under a depth of 20,000 ft. of water apparently raises problems

of enormous magnitude, but it is believed that they are not beyond present engineering skill.

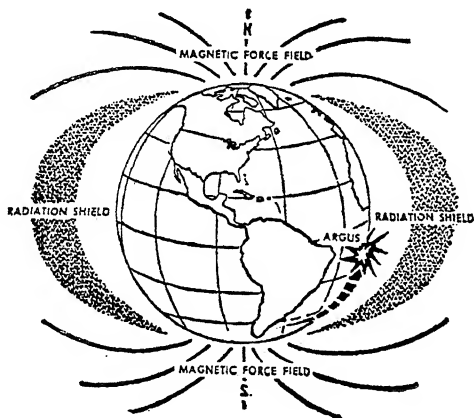
The choice of a site for the ocean borehole is one of major importance. The Moho should be as near as possible which means the ocean depth will be great, the weather should be good, and the effects of disturbing factors like ocean currents, etc., negligible, for it is no use to take arms against a sea 'of troubles'. One

suggestion is that the hole be dug in the Gulf of Mexico, north-west of Cuba, which has the additional advantage that the help of scientists from oil companies drilling for offshore oil would be available.

The progress of the ocean Borehole Plan of the Moho Committee of the American Miscellaneous Society (AMSOC) will be watched with great interest by scientists all over the world.

"PROJECT ARGUS": CREATION OF ELECTRON BELT AROUND THE EARTH

WHAT is likely to be one of the major achievements of the International Geophysical Year was the artificial creation of a trapped belt of high energy electrons around the earth, ranging to an altitude of about 4,000 miles and following the lines of the earth's magnetic field. This was the planned result of the U.S. Atomic Energy Commission project called the "Project Argus", in which three nuclear rockets were exploded at altitudes of about 300 miles, on August 27 and 30 and September 6, 1958, from naval ships stationed in the South Atlantic at about 41° S. latitude, due east of Patagonia.



The diagram shows the location and the results of the explosions last summer by the U.S. Atomic Energy Commission over the South Atlantic, "Project Argus". A radiation shield was formed around the earth by the enormous quantity of electrons ejected, open only at the polar regions, where the magnetic lines of force dip towards the earth.

—By courtesy of the *New York Herald Tribune* and the *'Hindu'* March, 29, 1959.

For the first time in history, geophysical phenomena on a world-wide scale were being related to a quantitatively known cause, namely, the injection into the earth's magnetic field of

a known quantity of electrons of known energies at a fixed position and time.

The man-made electron shell was not a simple blanket covering of the globe, but it followed the lines of the earth's magnetic field from pole to pole. According to Dr. Herbert York of the U.S. Defence Department, the electron belt was actually crescent-shaped in cross-section in the meridian plane. After each atomic burst it was only a matter of hours for the electrons to spread into the belt around the world. Each explosion was characterized by a brilliant initial flash of the burst, succeeded by a fainter but persistent auroral luminescence extending upwards and downwards along the magnetic line of force through the burst point. Almost simultaneously, at the point where this line of force returns to the earth's atmosphere in the northern hemisphere, near the Azores Islands, a bright auroral glow appeared in the sky which was observed from an aircraft previously stationed there in anticipation of the event. The satellite, Explorer IV, which was launched on July 26, 1958, moved through the trapped electron radiation hour after hour and day after day, in its orbital motion around the earth of periodic time about 110 minutes (see *Curr. Sci.*, 27 (12), 481). On its traverses through the electron shield, the counter tubes and telemetry instruments installed in the satellite recorded and reported to ground stations data about absolute intensity and position of this shell of electrons. The physical shape and position of the shell have been accurately plotted out and the decay of intensity has been observed. It is reported that the artificially induced radiation was about comparable to the radiation in the hottest parts of Van Allen Belt (Zone of cosmic or corpuscular rays trapped in earth's magnetic field).

The scientific findings are due to be published more fully at the annual meeting of the National Academy of Sciences on April 27-29.

CATCHING "BRAIN WAVES" ON TELEVISION SCREEN

ELECTRIC impulses exist in all the tissues and organs of the human body. Heartbeats are also attended by electric impulses. That has furnished the basis for the construction of the special instrument, electric cardiogram, which is of great value for diagnosing heart diseases.

The human brain, and the cerebral hemispheres especially, also discharge electrical impulses, which are, however, very faint, the electric impulses of the heart being hundreds of times more powerful. These impulses, like any other alternating electric current, create around themselves an alternating electromagnetic field, which in its turn creates electromagnetic waves. These "brain waves" are sent off into surrounding space and may be recorded by a sensitive receiver at a short distance.

Two Soviet engineers—Prof. M. Livanov and V. Ananyev, have designed an instrument for recording "brain waves" on television screen. Recently at the laboratory of the All Union Physics Research Institute of USSR Academy of Sciences Prof. Livanov demonstrated his instrument, the "Brain Televisor". The man whose brain waves were to be recorded on the TV screen was placed in a special chamber which was completely isolated from the possible action of electric interferences and outside noises. A special semi-spherical helmet with 50 contacts was placed upon the man's head. Each contact is a glass tube with fine metal conductors and cotton wicks inside. The cotton, steeped in a conducting liquid, was applied to the skin of the head. Communication with the man in the chamber was maintained only by telephone. Received by the contacts of the helmet the electric impulses of the brain were conducted by wires to powerful electronic amplifiers. The outlines of the cerebral hemispheres were on the screen of the TV tube, the convolutions were indicated by dotted lines.

The receiving set was switched on and flickering bright dots appeared on the outlines of the hemispheres. The dots signified electric currents received by the sensitive electrodes of the helmet from one or another region of the brain. Under the hemispheres on the TV screen, there was a shining diagram composed of fifty-five vertical lines, the length of which corresponded to the power of the charge of the electric impulses.

Five rows of dots, ten dots in each, were visible on the surface of the outline of the hemispheres on the TV screen. The dots disappeared and reappeared again, growing, their brightness changing, and the diagram of the power of the electric impulse changed accordingly.

Prof. Livanov asked the man in the chamber by telephone to solve a mathematical problem. One could see the shining dots on the screen change their brightness and distribution markedly, drawing together in groups. Then the dots gradually returned to their original position and paled away. The professor received the answer to the problem by telephone.

And so, while the man in the chamber was solving the problem, the electric impulses of the brain were more intensive than usual, which was reflected at once on the TV screen. When the problem had been solved, the electric impulses became fainter, and the TV screen showed that too.

The "Brain Televisor" is being used already with great success by doctors in diagnosing various cerebral disorders. It also affords the possibility of locating malignant tumours of the brain and finding their exact place. Should the cerebral cortex contain any affected places, the electric impulses there will be fainter, or will be absent completely, and this will be indicated immediately by the televisor.

—L. Yovich: *USSR News*.

ATOMIC LAMP

AN atomic lamp, which is expected to shine for at least ten years without attention or renewal of the power-source, has been made by a team of Harwell scientists led by Dr. Edward Wilson. The light is powered entirely by Krypton 85, a radioactive gas which is used to bombard the phosphor lining of the lamp and makes it glow. This gas will soon be available as a cheap by-product of atomic processes.

The atomic lamp is, however, not capable of replacing the type of bulb used for domestic and other lighting. It does not compare in intensity, at any rate for the moment. It should prove very useful wherever it is essential that the light-source should not go out accidentally. It could also be very valuable in mines and ammunition dumps, because it cannot cause an explosion.—*SACSIR Science News Selections*.

ACCELERATED RESAZURIN REDUCTION TEST FOR MILK

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National Dairy Research Institute, Karnal

AMONG the platform tests used for the rapid detection of poor quality milk supplies, received at the dairy plant or collection centre, the ten minutes resazurin test has been considered to be the most satisfactory method available for picking out samples having excessive numbers of bacteria and leucocyte cells.^{1,2} The need for adopting a much quicker method of testing milk supplies on the receiving platform is, however, widely recognised. In the course of the studies on the development of a suitable bacteriological test for the above purpose, the possibility of shortening the time taken for reduction of resazurin or methylene blue in milk by stimulating or accelerating the dehydrogenase activities of bacteria has been explored.

A number of substances, e.g., B. complex vitamins, amino acids, sugars, hydrolysates of casein, commercial peptones, yeast extract and beef extract, which are known to stimulate bacterial growth and metabolism, were added to milk and the effect on the reduction of resazurin and methylene blue was studied. Among the materials tried out, riboflavin was found to cause a slight acceleration in the reduction of the indicators when milk contained a preponderance of particular species of bacteria. Reducing agents such as ascorbic acid, cysteine and glutathione caused a marked reduction of the indicators but they were effective even in

pasteurised and boiled milks in the absence of any bacterial activity. It was, however, interesting to find that the addition of certain commercial peptones, yeast extract and beef extract in small concentrations had a very marked effect on the reduction of O/R indicators, particularly resazurin, in milk containing large numbers of actively growing bacteria. The addition of these materials to raw milk, containing very few bacterial cells, also showed some accelerating effect on the reduction of resazurin presumably due to the activation of some milk enzymes, but this effect was not produced in pasteurised and boiled milks. Paper chromatographic analysis of the peptone or yeast extract revealed that one particular component, which moved to a position corresponding to R_f value of about 0.51 in the chromatogram (butanol-acetate-water) appeared to be the activating factor.

The results of representative trials showing the effect of addition of peptone in different concentrations to milk samples, containing different levels of bacterial population, on the reduction of methylene blue and resazurin are shown in Tables I and II. It may be seen that the reduction of both the indicators is markedly accelerated by the addition of peptone and that this effect is progressively intensified with increase in the concentration of peptone as well as in the numbers of bacteria.

TABLE I

Effect of adding Stearn's peptone on the reduction of methylene blue and resazurin in milk*

Milk sample	Standard plate count per ml.	Methylene blue reduction time		Resazurin reduction disc numbers (Lovibond)					
				Without peptone			With peptone		
		Without peptone	With peptone	At the end of			At the end of		
				2 min.	10 min.	60 min.	2 min.	10 min.	60 min.
	(Millions)	(Hr. Min.)	(Hr. Min.)	(Disc Numbers)					
1	0.017	5-10	5-0	6	6	5½	6	5½	5
2	0.254	4-50	4-40	6	5½	5½	6	5½	5
3	0.450	3-50	3-15	6	5½	4½	6	5½	4
4	3.250	2-10	1-15	5½	5	3½	5½	5	3
5	20.500	0-22	0-15	5½	4	3	3	1	0
6	45.000	0-13	0-2	5	2½	0	½	0	0
7	91.000	0-8	0-2	4	½	0	0	0	0
8	150.000	0-5	0-1	4	½	0	0	0	0

* *Peptonum Siccum Stearns* (Frederick Stearns & Co., Detroit, U.S.A.).

Concentration: 0.2% (0.2 ml. of 10% peptone solution in 10 ml. milk).

TABLE II
Effect of adding Stearns peptone in different concentrations on the reduction of resazurin in milk

Milk sample	Standard plate count per ml.	Incubation time	Concentration of peptone				
			0.0	0.05	0.10	0.20	0.25
			(per cent.)				
(Millions)	(Minutes)	(Resazurin disc numbers)					
1	0.019	2	6	6	6	5½	5½
		10	5½	5½	5½	5	5
2	0.225	2	6	6	5½	5	4½
		10	5½	5½	5	4½	3½
3	6.110	2	5½	5	4½	4	2
		10	4½	4	2½	2½	1
4	33.000	2	5½	3½	2	½	½
		10	4	1½	1	0	0

It was also found that the resazurin disc numbers of milk samples containing peptone at the end of two minutes were generally comparable with the readings given by the corresponding control samples on the ten minutes reduction test. Thus, by adding a suitable concentration of the peptone, it may be possible to shorten the incubation time for the resazurin reduction test to less than five minutes and obtain information regarding the quality of milk supplies on the basis of which they may be accepted or rejected on the receiving platform. Based on these observations, a two minutes accelerated resazurin reduction test for milk has been developed and the results of some trials carried out to grade milk samples by the

new test as compared to the ten minutes resazurin test are shown in Table III.

TABLE III
Comparative grading of milk supplies by the Ten minutes and Two minutes (Accelerated) Resazurin tests

Grading by ten minutes Resazurin test (Disc number)	Number of samples	Distribution of samples according to resazurin disc numbers in the two minutes (accelerated) test (Disc numbers)				
		6, 5 & 4	3½ to 2	1½ to 1	½ to 0	
1 6, 5 & 4 (Good)	21	14	5	1	1	
2 3½ to 2 (Fair)	18	1	7	6	4	
3 1½ to 1 (Poor)	6	..	..	..	6	
4 ½ & 0 (Very poor)	17	..	..	..	17	

Further investigations are in progress to isolate the particular fraction of peptone responsible for accelerating the reduction of resazurin in milk and to study the practical application of the method for the rapid bacteriological examination of milk supplies on the receiving platform.

1. Ministry of Agriculture and Fisheries, England, (1942), Form C. 150 (T.P.Y.), H.M.S.O., London.
2. Gurbhagwant Singh, Laxman Rao, M. R. and Laxminarayana, H., *Indian J. Dairy Sci.*, 1948, 1, 11.

SOME IGY DATA ON ANTARCTICA

THE scientific exploration projects of the Antarctic and the south polar region under the IGY programme have led to an accumulation of data on such wide ranges of subjects as aurora and airglow, ionospheric physics, cosmic rays, geomagnetism, oceanography, glaciology, gravity measurement and special studies in botany, zoology and microbiology. These data from groups of observers from different stations, when analysed, co-ordinated and published are bound to add greatly to our knowledge of the ice-sheathed continent.

Seismic measurements of ice thickness indicate that there is probably 40% more ice in the Antarctic than previously thought. The U.S.-IGY team at Bryd Station measured ice 14,000 ft. thick, resting on bed rock 8,200 ft. below sea level. This may be the thickest ice measured anywhere in the world. Deep drilling operations to more than 1,000 ft. depth have brought up cores of ice which fell as snow over 1,000 years ago. Analysis of the ice cores is expected to throw more light on past climates. A record low temperature of -125.3° F. was reported by the USSR-IGY station near the centre of the continent. It was reported that during the Antarctic mid-summer the south pole receives more sunlight than any other place on earth. But as nearly 95% of the radiation is reflected by the ice cover the pole itself is left one of the coldest spots in the world.—*Bull. Am. Met. Soc.*, January 1959,

LETTERS TO THE EDITOR

REVERSE-PHASE CHROMATOGRAPHY
OF FAT-SOLUBLE DYES

In previous communications from this Laboratory¹⁻² methods have been described for carrying out the chromatography of fat-soluble dyes on filter-paper treated with liquid paraffin, silicone, etc. A number of eluants employed for the development of chromatograms have also been described there.

On extending the investigations to the analysis of mixtures of fat-soluble dyes it was noted that a very clear resolution of a dye mixture into its constituents is obtained if the chromatograms are run at $30^\circ \pm 1^\circ \text{C}$. on a liquid paraffin-impregnated paper, using mixture of acetone and water (70 ml. + 30 ml.) and acetone, pyridine and water (25 ml. + 10 ml. + 40 ml.) as the developing agent. The dye spots that separate out on the treated paper are compact and give fairly reproducible R_f values. A typical chromatogram is given in Fig. 1.

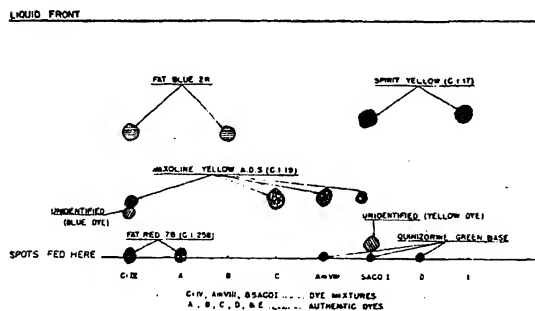


FIG. 1

The latter eluant has been described by Fujii³ for untreated paper.

Full details will be published elsewhere.

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New Delhi-12, JITENDRA RAI.
December 18, 1958.

STUDY IN ELECTRODE OF THE THIRD
KIND: ACTIVITY COEFFICIENTS
OF CALCIUM CHLORIDE IN DILUTE
AQUEOUS SOLUTIONS

THE thermodynamic properties of a salt solution by means of electrode of the third kind has been studied by only a few investigators. Le Blanc and Harnapp¹ using electrode $\text{Hg}/\text{Hg}_2\text{WO}_4 - \text{CaWO}_4 - \text{Ca}$ and $\text{Hg}/\text{Hg}_2\text{C}_2\text{O}_4 - \text{CaC}_2\text{O}_4 - \text{Ca}$ reported that only the second cell is serviceable. According to these authors the electrode $\text{Cd}/\text{Cd stearate} - \text{Ca stearate} - \text{Ca}$ is also unsuitable since it does not respond to the changes in Ca . Schmidt and Greenberg² have experienced difficulties in attaining equilibrium with a zinc oxalate electrode. It seems that in their studies with the electrode of the third kind the technique was inadequate. The cell should be designed to maintain strictly oxygen-free condition as oxygen renders the electrode unreliable.

The activity coefficient of calcium chloride in dilute aqueous solution has been determined by using the cell of the type: $\text{Pb} - \text{Hg}/\text{PbC}_2\text{O}_4/\text{CaC}_2\text{O}_4/\text{CaCl}_2 (m)/\text{AgCl} - \text{Ag}$. The electrode reaction is $\text{Pb} + \text{CaC}_2\text{O}_4 = \text{PbC}_2\text{O}_4 + \text{Ca}^{+2} + 2e$, which behaves reversibly with respect to calcium ions. Electrodes of this type employing single concentration cell in dilute solutions are useful in determining the activity of the metallic ions, the metals of which cannot be used as electrode of the first or second kind owing to their reactions with aqueous solutions. The technique involved in the operation of this type of cell and the apparatus employed are similar to those of Joseph.³ The improved apparatus is a H-shaped cell with two stop-cocks so that air could be expelled from the vessel. The tube containing the electrode lead amalgam in contact with solid lead oxalate and calcium oxalate was placed in the cell and made tight at the ground glass joint. Mercury was placed in the cup as illustrated in another paper⁴ to make it air-tight. Silver-Silver chloride electrode was also tightly inserted on the other side of the cell. Collodion was not used for fixing the cellophane to the glass as described in earlier method³ but tied by means of a thread.

The stock solution of calcium chloride was made up by dissolving a weighed amount of

1. Verma, M. R. and Ramji Dass, *J.S.I.R.*, 1957, 16 B, 131.

2. — and —, *Naturwiss.*, 1957, 44, 351.

3. Fujii, S., *Bull. Nat. Hyg. Lab.*, 1955, 73, 335.

extra pure calcium chloride in a weighed amount of conductivity water. The solution was stored in an atmosphere of hydrogen. Silver-Silver chloride electrode was prepared by the method of Spedding, Porter and Wright.⁵ Lead amalgam was prepared in accordance with the direction of Cowperthwaite and La Mer.⁶ Freshly precipitated pure lead oxalate and calcium oxalate were used in most of the experiments. The apparatus was placed in a water thermostat maintained at 25° C. and the E.M.F. measured with a potentiometer at intervals of ten minutes.

Generally, the equilibrium between the calcium chloride solution and the two solid phases was established within an hour. While experimenting with cell employed by Joseph without replacing air by hydrogen, the E.M.F. showed a tendency to fluctuate. This difficulty increased with the increase of concentration of calcium chloride and consistent reproducible E.M.F. was not obtained.

TABLE I

Molality (<i>m</i>)	<i>e</i> in volt			$-(e - e^*)$	$-\log \gamma/\gamma^*$	γ
	1st Determi.	2nd Determi.	Mean			
0.0010	0.5672	0.5672	0.5672	0.0000	0.0000	0.888
0.0020	0.5424	0.522	0.5423	0.0249	0.02042	0.84721
0.0050	0.500	..	..	0.0572	0.05433	0.78538
0.010	0.4863	0.4865	0.4864	0.0808	0.08941	0.72277
0.020	0.4634	0.4634	0.4634	0.1038	0.13113	0.61657
0.050	0.4335	0.4339	0.4337	0.1335	0.19447	0.56747
0.060	0.4298*	..	..	..	..	..
0.080	0.3526*	..	..	..	..	..

* Satisfactory equilibrium not reached.

The electromotive force (*e*), activity coefficient (γ) and the concentration (*m*) are related according to the equation :

$$e - e^* = - \frac{3RT}{2F} \ln \frac{\gamma m}{\gamma^* m^*}$$

where e^* , m^* and γ^* are the E.M.F., molality and the activity coefficient respectively of the most dilute solution of the series (Standard E.M.F. of the cell). In calculating the values of the activity coefficient in Table I, it was assumed that γ is 0.888 at 25° C. for 0.001 *m* CaCl₂ solution based on the result of Scatchard and Tefft.⁷

Activity coefficients of the aqueous solutions of calcium chloride have been determined by E.M.F. method using mostly calcium amalgam electrode. Robinson⁸ has suggested that in all these measurements the calcium amalgam electrode is not reversible and according to him

the results of earlier investigators are, therefore, doubtful. The electrode employed in the present investigation is free from such objections. The results obtained in Table I on the activity coefficients of calcium chloride in dilute aqueous solutions by the use of electrode of the third kind are in good agreement with those found by other methods.

Department of Chemistry,
Ranchi College, Ranchi,
October 10, 1958.

J. N. SAHAY.

1. Le Blanc and Harnapp, *Z. physik. Chem.*, 1937, **166 A**, 221.
2. Schmidt and Greenberg, *Physiol. Rev.*, 1935, **15**, 239.
3. Joseph, *J. Biol. Chem.*, 1938, **126**, 391; *Ibid.*, 1939, **130**, 203.
4. Sahay, J. N., *Curr. Sci.*, 1958, **27**, 247.
5. Spedding et al., *J. Amer. Chem. Soc.*, 1952, **74**, 2781.
6. Cowperthwaite and La Mer, *Ibid.*, 1931, **53**, 4333.
7. Scatchard and Tefft, *Ibid.*, 1920, **52**, 2272.
8. Robinson, *Trans. Faraday Soc.*, 1940, **36**, 735.

BLOOD TRANSAMINASE STUDIES IN PROTEIN REGENERATION

It was observed by Phansalkar, Ramachandran and Patwardhan (1958) that in adult rats the total circulating haemoglobin and plasma proteins were reduced by 56% and 48% respectively when these animals were fed protein free diet for eight weeks. When protein repletion was commenced at this period with two vegetable protein mixtures (a) wheat, red gram and amaranth, (b) bajra, red gram and amaranth using skim-milk as control, the blood proteins tended to return to normal on all the three diets within three weeks. However, the rate of regeneration of haemoglobin and plasma protein was slower on vegetable protein diets than on skim-milk.

Tulpule and Kshirsagar (1958) have observed that glutamate-oxaloacetate transaminase (GOT) activity in whole blood was decreased when the rats were maintained on low protein but otherwise complete diet and the enzyme activity returned to normal when adequate protein was restored in the diet. It was considered worthwhile, therefore, to study the GOT activity of blood during protein regeneration and to compare the results with the changes in blood proteins.

Forty male albino rats, four months old, with an average weight of 225 g., were fed protein-free diet for eight weeks. The rats were then divided into three groups and fed the diets containing the following foods as sources of protein ;

Diet 1. Skim-milk (10% protein).

Diet 2. Wheat (6% protein) + red gram (3% protein) + amaranath (1% protein).

Diet 3. Bajra (6% protein) + red gram (3% protein) + amaranth (1% protein).

During the protein repletion period, the same amount of diet was fed to all the rats in each of the three groups every day to ensure identical intake of protein and calories in different groups. At the end of the protein depletion period and at different intervals during blood protein regeneration in the animals on the three types of diets mentioned earlier, blood samples were drawn by cardiac puncture and GOT activity of blood was determined by the method of Tonhazy, White and Umbreit (1950) using hæmolysed whole blood as the source of enzyme. The blood samples were also analysed for hæmoglobin, plasma proteins and total blood volume as has already been described by Phansalkar *et al.* (*loc. cit.*).

activity was associated with the increase observed in total circulating hæmoglobin and plasma proteins over the depletion levels. There was a further increase in the enzyme activity in all the groups on the seventh day and in the subsequent period up to 21 days the changes in the enzyme activity were comparatively small. Although the rate of regeneration of blood proteins in animals on vegetable protein diets was lower than that on skim-milk diet (Phansalkar *et al.*, *loc. cit.*), no difference was noticed in blood GOT activities on the vegetable and milk diets.

These observations strengthen the view that the apoenzyme of GOT is susceptible to the level of dietary protein intake.

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Indian Council of S. V. PHANSALKAR.
Medical Research, M. RAMACHANDRAN.
Coonoor, S. India,
October 11, 1958.

TABLE I
Effect of protein repletion on blood GOT activity in protein depleted rats

Diet	After eight weeks of protein depletion				Days after restoration of protein in diet							
					3				7			
	No. obs.	GOT units	Total circulating Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Total circulating Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Total circulating Hb. (g.)	Plasma proteins (g.)
Skim-milk ..	12	114	1.453	0.263	4	165	2.358	0.470	4	246	2.862	0.518
Wheat + red gram + amaranth	14	101	1.427	0.255	4	162	2.131	0.473	5	199	2.665	0.502
Bajra + red gram + amaranth	14	100	1.393	0.227	4	153	1.965	0.438	5	239	2.403	0.461

Diet	Days after restoration of protein in diet							
	14				21			
	No. obs.	GOT units	Total circulating Hb. (g.)	Plasma proteins (g.)	No. obs.	GOT units	Total circulating Hb. (g.)	Plasma proteins (g.)
Skim-milk ..	4	211	2.843	0.542	4	224	2.995	0.596
Wheat + red gram + amaranth	5	212	2.972	0.558	7	213	3.056	0.515
Bajra + red gram + amaranth	5	235	2.523	0.513	8	247	2.837	0.537

GOT unit: μ g. pyruvic acid formed by 1 c.c. of blood in 10 minutes reaction at 37° C.

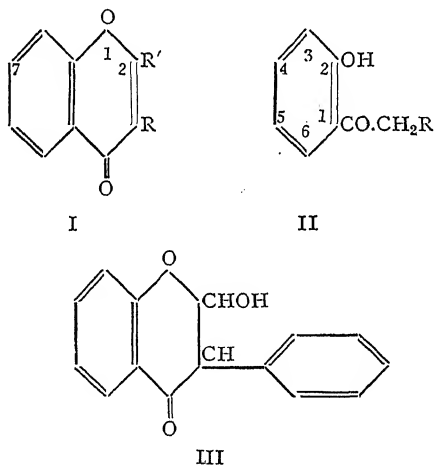
Blood GOT activity of stock control rats (average of six observations) — 176 units.

It will be seen from Table I that at the end of eight weeks period of protein depletion, blood GOT activity was considerably reduced as compared to the stock controls. Activity of GOT in blood increased by about 50 to 60% within 3 days of the start of protein repletion in all the three groups. This increase in enzyme

1. Phansalkar, S. V., Ramachandran, M. and Patwardhan, V. N., *Indian J. Med. Res.*, 1958, **46**, 333.
2. Tonhazy, N. E., White, N. G. and Umbreit, W. W., *Archiv. Biochem.*, 1950, **28**, 36.
3. Tulpule, P. G. and Kshirsagar, S. G., *Indian J. Med. Res.*, 1958, **46**, 452.

ON THE USE OF METHOXALYL
CHLORIDE IN ISOFLAVONE
SYNTHESIS

VARIOUS sources of the C_2 -atom in the synthesis of isoflavones (I, R = phenyl, R' = H) from benzyl-o-hydroxy phenyl ketones (2-hydroxy deoxybenzoin) (II) are known; but the synthesis of hydroxy isoflavones, without the protection of hydroxyl groups in hydroxy-deoxybenzoin has only been achieved recently. Baker *et al.*¹ used ethoxalyl chloride as the source of the C_2 -atom while Farkas² obtained it by the action of hydrochloric acid gas on zinc cyanide, the former being most widely employed. The use of methoxalyl chloride for isoflavone synthesis has not so far been reported. The present work deals with the use of methoxalyl chloride in order to see (i) if it would be more efficient than ethoxalyl chloride and (ii) if it would give almost invariably 2-hydroxy isoflavones³ (III) in place of isoflavones (I, R = phenyl, R' = H) as is the case when methyl formate is used instead of ethyl formate in isoflavone synthesis.



In the course of our work it has been found that methoxalyl chloride is more efficient as far as the yields of the intermediate esters and their ease of hydrolysis are concerned. There is no formation of 2-hydroxy-isoflavones.

The use of this source of the C_2 -atom has yielded 7-hydroxy (I, R = phenyl, R' = H, OH at 7) and 5, 7-dihydroxy isoflavones (I, R = phenyl, R' = H, OH at 5 and 7) in yields of about 70%, identical with the products prepared by the ethoxalyl chloride method.⁴

The intermediate esters, 2-carbmethoxy-7-hydroxy isoflavone (I, R = phenyl, R' = COOMe,

OH at 7), m.p. 220-22° and 2-carbmethoxy-5, 7-dihydroxy isoflavone (I, R = phenyl, R' = COOMe, OH at 5 and 7), m.p. 220-21° not reported earlier, have also been obtained. They have been identified by hydrolysis to the corresponding acids which were confirmed by mixed melt with authentic samples of the acids obtained by ethoxalyl chloride method.⁴

Further work is in hand.

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November 5, 1958.

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W. RAHMAN.
Kh. T. NASIM.
M. A. SIDDIQUI.

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4. Baker, Chadderton, Harborne and Ollis, *J. Chem. Soc.*, 1953, 1852.

CHROMATOGRAPHIC DETECTION OF
THE ORGANIC CONSTITUENTS OF
GORIKAPULI (GARCINIA CAMBOGIA
DESR.) USED IN PICKLING FISH

EFFICIENT preservation of fish over long periods is achieved by "Colombo" method, *viz.*, pickling in brine containing *Gorikapuli* or *Kodapuli* or Malabar Tamarind (dried fleshy pod of *G. cambogia*).⁷ In this note an attempt is made to correlate the effect with the constituents of the preservative.

Ceylon pod (15-20 g.) imported by Malpe merchants was acidified with acetic acid (omitted for detection of amino acids),⁶ ground with 70% ethanol and filtered through fine cloth. The centrifuged filtrate was made up to a definite volume and aliquots were used for detecting organic acids⁴ and sugars.^{2,3} Both aqueous and ethanolic extracts were used for detection of polyphenols,¹ which were developed on paper chromatograms with the solvent system butanol-acetic acid-water (4:1:5) and sprayed with ferric chloride or ammoniacal silver nitrate.

No free amino acids were found in ethanolic or aqueous extracts. A band corresponding to fructose-arabinose-xylose was noticed. While aqueous extracts apparently lacked polyphenols, a fast moving polyphenol in ethanolic extract unidentifiable by R_f value with any known tannin, was located very near the solvent front. No volatile acid could be detected but citric

and tartaric acids⁸ (cf. occurrence of malic and tartaric acids in tamarind from *Tamarindus indica*)⁵ were present, which apparently lowered the pH of the pickling medium to 5.4, and thereby featured as bacteriostats. Absence of *Staphylococcus* in the cured product may be attributed to this, as was affirmed by Ingram, in a discussion.⁷ The role of a reducing sugar and of the polyphenol in preservation of fish by this process is worth studying.

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SYNTHESIS OF TARTARIC ACID IN TAMARIND LEAVES

THE fruit of the Tamarind tree (*Tamarindus indica*, Linn.) is the most acid of all natural foods, the content of the chief acid present, tartaric, being as high as 14-18%.^{1,2} The seat of synthesis of the acid is in the leaves, which maintain a high concentration of tartaric acid during the first few months of the season. The acid synthesised is apparently continuously translocated to the berries, which are very sour from the beginning to the ripening stage, containing about 11% free and 5% combined acid. The only acids in the leaves are tartaric and malic,³ and we have found that the berries also contain only these two acids, identified chromatographically. There is no known path-

way of metabolic utilisation of tartaric acid in plants.⁴ Although in some plants like the grape, a certain degree of metabolic utilisation of tartaric acid is assumed during ripening nevertheless, it remains a difficult substrate for oxidation. Unlike in the case of other fruits, ripening in the case of tamarind fruit is not accompanied by any decrease in the acid content (about 16-18% in both). The accumulation of invert sugars to the extent of 30-40% during the ripening stage gives the harvested fruit a sweeter taste.

It was of interest to study the composition of the leaves at different stages of fruit growth, starting from the time the fresh bright green foliage comes up (April-May) followed by the appearance of flowers and then small berries, and ending with the time the fruit is ready for harvest (January-February) and when the leaves are a dark dull green. The results are graphically given in Fig. 1. Standard methods of A.O.A.C. were used for analysis.⁵

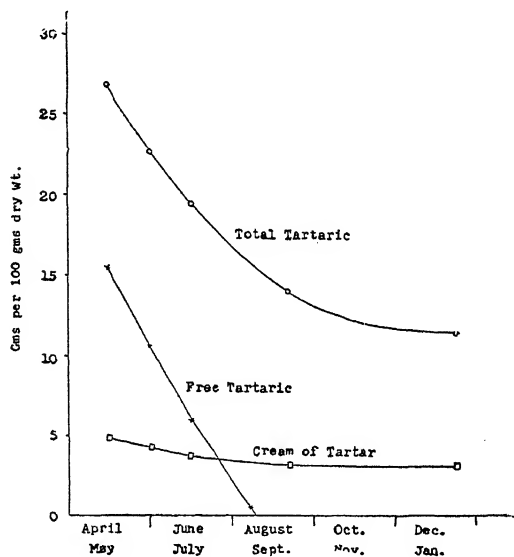


FIG. 1

Total tartaric acid and free tartaric acid are maximum in the fresh foliage. The vigorous metabolic processes going on at this stage are responsible for this. Blocking of enzyme systems necessary for further oxidations is supposed to be responsible for such accumulation of acids. Tartaric acid is an uncommon plant acid. Although other mechanisms for the synthesis of tartaric acid are doubtless equally likely, there is a possibility that the accumulation of this substance in certain plants is the result of a metabolic conversion of α -glucose

whereby carbon atoms 5 and 6 are removed, leaving a 4-carbon unit which is oxidised to the dicarboxylic acid. Being of a configuration that cannot be further attacked by the enzyme systems present (+)—tartaric acid accordingly accumulates. This oxidative mechanism of glucose is uncommon.⁶ Whatever be the mechanism of acid production-carbohydrate breakdown, CO₂ fixation or amino-acid degradation, the tartaric acid formed does not enter back into the metabolic cycle. In starvation experiments conducted with excised leaves according to the technique used by Puchel *et al.*⁷ we could not detect any decrease in tartaric acid content even under extreme starvation. Neither oxalic nor tartaric acids fit into known organic acid metabolic systems. The accumulation of acid to a high concentration in the leaves during the first few months of the season implies that the rate of production of the acid exceeds the rate of withdrawal. Since metabolic utilisation is very sluggish, if at all, the only outlet for the acid produced is translocation to the berries. As the berries grow bigger, they can take up most of the excess acid from the leaves in addition to synthesising some of their own, and the free acid content of the leaves ultimately drops to zero. Meanwhile, more calcium is also absorbed to neutralise the excess acid in the leaves (Fig. 2).

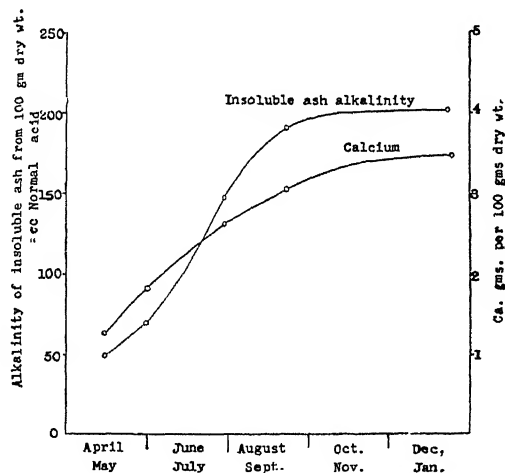


FIG. 2

Grateful thanks are due to Dr. D. S. Bhatia and Director Dr. V. Subrahmanyan for their interest in the work.

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EXPERIMENTS ON PICKLING FISH WITH VINEGAR AND MALABAR TAMARIND*

It has been suggested by Venkataraman and Sreenivasan¹ that "Malabar Tamarind" (from *Garcina cambogia*) helps in the fermentation of fish in the "Colombo Curing" method owing to citric acid, tartaric acid and some polyphenols lowering the pH of the pickling medium and thereby inhibiting the growths of spoilage organisms. The use of vinegar for this purpose has now been explored.

Fresh oil sardines gutted and well washed, were packed in two sets of porcelain jars with one-third the weight of salt (I.S.I.).² To one set, 5% by weight of tamarind and to the other 5% by weight of vinegar containing 5% of acid (expressed as acetic acid) were added. Within two days, self-brain covered the fish to the top. The rate of spoilage in the two sets has been adjudged by taking samples periodically and estimating pH, total volatile bases (TVB),³ Trimethylamine (TMA),³ total count (TC), halotolerant count (HTC) and red halophilic count^{5,4} (*vide* Table I). Anaerobes (plated on thioglycollate agar using spray dish technique) and acid tolerant organisms (Thermoacidurans agar)⁶ were enumerated after six months to ascertain the extent of residual microflora. In the first set, this rate seems higher (from TVB and TMA values) and HTC, but not TC, goes up after two months although final TMA value in both sets are the same and well below spoilage level. The pH rises from 6.0 to a steady value 6.4 in a month while that of vinegar-brine changes from 5.2 to 6.0 falling to a steady value 5.4 after another month, the titratable acidity being 1.6 times higher than in the first set. The aerobic flora consisted of sporeformers, besides a few slender rods and a coccus. The anaerobes were long filamentous, non-spore

* A paper read at the 45th Session of Indian Science Congress, Madras, 1958 and published with the kind permission of Director of Fisheries, Trivandrum.

Analytical data of the fresh and pickled fish showing changes in Bacterial count ($10^3/\text{gm.}$)
TVB, TMA and pH values

Total viable counts of fresh fish				Tamarind pickled sardines						Vinegar pickled sardines									
Date	Whole fish	Gutted fish	Gutts and Gills	Fish		Brine		Fish		Brine		Fish		Brine		Fish		Brine	
				TC	HTC	TC	HTC	TVB	TMA	pH	TC	HTC	TC	HTC	TVB	TMA	pH		
2 days	4.8	0.8	3.73	1650	308	..	..	..	6	1840	294	..	..	..	..	..	..	5.2
32 days	..	..	..	156	..	56	28	14	0.35	6.4	250	..	419	340	14	0.35	6.0	..
63 days	..	..	..	84	14.1	89	8.1	105	0.7	6.4	4.7	8.4	162	6.8	85	0.35	5.4	..
6 months	..	..	..	680	1080	10	34	70	0.7	6.4	6.20	20	29	3.07	54.3	0.7	5.4	..
For salt used																			
				TC	HTC	RHC													
				84000	400	Nil													
						20†													

† The medium used for the red halophiles is supposed to be selective. Still white colonies of rods were seen on, the salt-milk-agar.

forming rods and a short spore-forming rod. These did not digest or blacken liver infusion broths but formed gas even at pH 6.0. It is likely that they aid in keeping down the growth of spoilage organisms as suggested by Venkataraman and Sreenivasan.

The vinegar treated sardines were silvery white, their flesh being flaky, soft and of fruity flavour unlike the tamarind treated ones which were brown and hard covered in rancid brine. When fried they were like fresh fish save for the slight taste of the added agents. Vinegar treated sardines are better as judged from taste, appearance and also TVB and TMA values and thus the use of vinegar for pickling can be recommended.

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'ANORTHOSITE', A NEW FIND FROM AURANGA-KOEL-VALLEY, PALAMAU, BIHAR

A SMALL patch of anorthosite occurs near the magnetite deposits at Biwabathan village ($23^{\circ} 55' \text{N.} : 84^{\circ} 3' \text{E.}$). The anorthosite is a white coarse-grained rock resembling white marble in appearance and is very compact and massive. The fresh surface of the rock gives shining lustre on account of the reflection of light from cleavage faces of the feldspars, which show at times very fine twin striations also. Feldspars up to 1 to $1\frac{1}{4}$ " in length have been observed. The average specific gravity of the rock is 2.7.

Under the microscope the rock shows well developed plates and smaller euhedral to sub-hedral grains of feldspars which constitute the bulk of the rock. Albite twinning is well developed and is universal (see Fig. 1). The symmetrical extinction angle varies between 35° and 40° . The optical axial angle of a clear piece was determined directly by the five axes stage and was found to be 78° with a positive sign. Thus the extinction angle and 2V indicate a composition of the plagioclases as having 53% An. Besides plagioclase, the rock contains hornblende, hypersthene, epidote-zoisite, scapolite, sphene and secondary quartz. On analysis the following result (percentage) was obtained :—



FIG. 1. Microphotograph of the rock section B.7 showing well developed albite twinning in feldspars and accessories.

SiO ₂	..	54.27
Al ₂ O ₃	..	26.70
Remaining (FeO, Fe ₂ O ₃ , TiO ₂ , P ₂ O ₅ , etc.)	..	1.51
CaO	..	12.90
MgO	..	Traces
Na ₂ O	..	4.50
K ₂ O	..	0.20
Loss on ignition	..	0.83
TOTAL	..	100.91

The most striking feature of this anorthosite is its association with gabbroic rocks on the one hand and tremolite-schists, marbles, calc-silicate and granulites on the other. Sen and Roy Chowdhury¹ have reported the occurrence of anorthosite from Manbhum District of Bihar associated with calc-granulites, which they think, was formed by the high grade metamorphism of calcareous sediments with sufficient aluminous impurities. It is expected that a detailed study of the Palamau anorthosite will indicate whether it is magmatic or metasomatic metamorphic in origin.

Thanks are due to Dr. S. C. Chatterjee, Tata-Professor of Geology, Patna University, under whose supervision the work is under progress, and to Dr. G. C. Bhattacharya of the Chemistry Department of Ranchi College for his help in the chemical analysis of the rock.

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RENAL CLEARANCE OF UREA

It has been stated that Indians have a lower urea clearance than Europeans and Americans.^{2,10} A similar study carried out on the services personnel^{11,12} failed to confirm these observations and showed that if blood urea was raised, whether by high protein diet or by ingestion of urea, the urea clearance increased. Object of this paper is to show that the renal clearance of urea is not related to race or any specific biological action of proteins, but is a function of the nitrogen load put on the kidney during the test.

To measure the true clearance of urea, which could be done only at a constant blood urea level, 5 healthy persons were given 15, 20, 25 and 35 g. of urea in 4 different experiments, and the bloods were collected at 30, 60, 90, 120 and 150 minutes after urea ingestion. Urea clearance was calculated from the highest blood urea and the output of urine in the last 60 minutes. The findings are presented in Fig. 1 and Table I. It is seen that:—

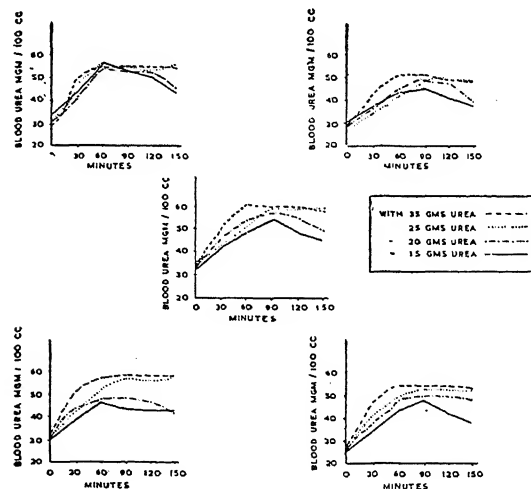


FIG. 1. Blood urea curves in 5 persons after ingestion of varying quantities of urea.

1. With 25 and 35 g. of urea, a constant range of blood urea is obtained at 90 minutes and this lasts for more than one hour,

TABLE I

Urea clearance test on 5 persons with 15, 20, 25 and 35 g. of urea orally

Serial No. (1)	15 g. (2)	20 g. (3)	25 g. (4)	35 g. of urea (5)
1	70	75	94	96
2	65	83	90	89
3	77	90	99	101
4	59	66	79	80
5	52	70	85	82

All clearances were maximal clearances. Figures in columns 2, 3, 4 and 5 represent number of ml. of blood cleared of their urea.

2. The level of constant blood urea varies with individuals, but it remains lower than 60 mg.%.
3. Urea clearance acquires its peak with nitrogen load of 25 g. of urea.

Accordingly, 50 medical category 'A' subjects were tested for their urea clearance by the following procedure: The test was started 1½ hours after breakfast. The subject was given 25 g. of urea dissolved in 200-300 ml. of water and then allowed to rest. After 90 minutes the subject emptied his bladder and the urine was discarded. A sample of blood was collected for the base line of urea. The subject rested for further 60 minutes. Another specimen of blood was obtained for urea level at termination, and the entire quantity of urine that was formed and voided during the last 60 minutes preserved. The quantity of this urine was measured to the last ml. Urea in the two specimens of blood and the last urine was determined by the usual method. If the two blood ureas differed from each other by more

TABLE II

Urea clearance test on 50 healthy services personnel with 25 g. of urea

	No. of persons tested	Age	Surface area sq. M.	Blood urea mg. %	Urea clearance
Maximal clearance	32	34.1	1.71	51.7*	93.1
SD	..	7.0	0.09	6.2	18.1
Standard clearance	18	36.8	1.69	51.4	67.8
SD	..	6.8	0.11	4.3	8.0

* There were only two persons who had a blood urea level higher than 60 mg.%. Repeated urine examination and a thorough clinical check up in both of them failed to reveal any abnormality.

than 5 mg.%, the test was repeated. The observations are presented in Table II, from which it can be inferred that the values so obtained are higher than the average clearance obtained in Europeans and Americans, and our own findings.¹¹ It was seen in these experiments that the rise in the urea clearance was due to increased concentration of urea in urine, and not due to diuresis.

Repeat tests were done on 10 of the above subjects with (a) 600 ml. of plain water, and (b) 15 g. of urea dissolved in 200 ml. of water followed by a further drink of 400 ml. of water. Comparison of these two and the findings with 25 g. of urea is presented in Table III, which shows that the clearance of blood urea rose with the increase in nitrogen load in all of them.

Rise in the renal clearance of urea with increase of dietary protein intake, recorded in literature,^{3,4,6,8} has been explained by (a) the resultant hypertrophy of the kidney,^{7,9,13} and (b) elevation of the level of blood urea.¹ Rise in urea clearance following increased intake of proteins has been found to be transitory^{3,6} and there was regression with reversion to low protein diet; in animals there was even regression in kidney weight.⁹ A similar effect on the urea clearance was observed in nephrotic children when they were fed creatinine.⁴ Urea has also been found to be effective in this respect but to a lesser degree.⁷

Data presented in this paper confirm the observation that the increase in urea clearance resulted from the rise of blood urea. In view of the above and particularly if the ingestion of a single large dose of urea could produce so profound changes as seen in Table III, there does not seem to be any justification in attaching special importance to the role of proteins in raising the urea clearance.

The observations recorded here and earlier¹² confirm the findings of Goldring and Chassis,⁵ though indirectly, in that the blood urea did not rise beyond 60 mg.% and there was increased excretion of urea in urine, in spite of the heavy nitrogen load.

The term maximal clearance apparently indicates the maximal capacity of the kidney to clear urea. Data given in Table III show that values generally obtained in clinical laboratories, whether with or without urea and when the rate of output of urine was more than 1.5 (2) ml. per minute, do not represent the maximal urea clearing capacity of the kidney. In view of variations in renal clearance of urea with changes in the nitrogen load, it is suggested that three terms should be used, viz., "standard clearance",

TABLE III

Urea clearance in 10 persons with plain water,
15 g. of urea dissolved in 600 ml. of water and
25 g. of urea in 200-300 ml. of water

Sl. No.	Clearance in ml. with plain water	Clearance in ml. with 15 g urea	% increase in clearance by addition of 15 g. urea	Clearance in ml. with 25 g. urea	% increase in clearance over plain water	% increase in clearance over 15 g. urea
1	56	71	26.8	98	75	38.0
2	60	81	35.0	104	73.0	28.4
3	63	77	22.2	92	46.0	19.4
4	50	63	26.0	85	70.0	35.4
5	54	69	27.7	88	63.0	27.5
6	63	86	36.5	110	74.6	28.0
7	49	62	28.5	79	62.1	25.4
8	42*	58*	38.1	84	..	..
9	51	56*	..	97	76.4	..
10	59	70	18.6	99	64.0	38.5

All the clearance values have been given as the nearest whole number.

* Standard clearance.

"optimal clearance" and "maximal clearance". It is further suggested that the term commonly employed in clinical laboratories to indicate the output of urine of more than 1.5 (2) ml./minute be changed to optimal clearance. These changes fit in with the concept of actively functioning and reserve (sleeping) nephrons. With no load of nitrogen in the test with plain water, clearance seems to be effected by the small number of working nephrons. As the nitrogen load increases, increasing number of reserve nephrons are put into commission, till they reach the maximal capacity whence the urea clearance becomes constant.

Author's thanks are due to Subedar B. V. Murti, B.Sc., for technical assistance.

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MAGNETIZATION OF A METADOLERITE DYKE IN RELATION TO ITS PETROGRAPHY

A MAGNETIC study of portions of metadolerite dyke exposed in Dhaiya village, Dhanbad, and its extension into the Indian School of Mines premises was undertaken. The fieldwork includes a magnetic survey of the dyke with a vertical force variometer and collection of oriented samples of the rocks from various portions of the dyke. The laboratory investigation includes a study of the petrography and magnetic properties such as permanent and susceptibility polarizations and direction of magnetization of the dyke.

The country rock here is quartz-felspathic gneiss. A metadolerite dyke runs in a N.N.W.-S.S.E. direction. The portion of the dyke in the School campus is a typical metadolerite while in Dhaiya area along with metadolerite there occurs epidiorite, which shows at places typical Rapakivi structure. The epidiorite and metadolerite seem to be genetically connected; the former may be a product of metamorphism and felspathisation of the latter.

The basic dyke rocks in the area under investigation may be grouped as:

- (i) Non-felspathised, i.e., metadolerite,
- (ii) felspathised, i.e., epidiorite. The non-felspathised rock is greyish black in colour showing good laths of grey coloured felspar in hand specimens. Under the microscope it shows typical ophitic texture. Both orthorhombic and monoclinic pyroxenes are found. They show alteration to green uraltite especially along the periphery. Some grains of pyroxene are fresh. The felspar is labradorite and shows typical cloudiness. Biotite shows strong pleochroism. Large grains of magnetite are found enclosed in pyroxenes and biotite. A little quartz is present in some sections. The felspathised rocks are rather light coloured and coarse grained and are either slightly gneissose or granulitic in structure. The sections show much alteration of pyroxenes to hornblende and even to biotite. Large crystals of felspar are

seen enclosing small grains of the ferromagnesian minerals. Garnet is usually present. Quartz shows undulose extinction. Ophitic texture is completely lost and the rock has acquired granulitic texture. Magnetite is found as large irregular grains enclosed in pyroxene and biotite. The Rapakivi-like structure in this area described by Sharma and Agrawal¹ is considered as a special case of feldspathisation of the basic rock.

Observations for vertical intensity of the earth's field were taken over the dyke using Askania vertical force variometer. Six traverses were laid across the dyke, three in Dhaiya area and three in the School of Mines campus. Pronounced magnetic anomalies were observed over the portions of the dyke in the School campus (non-feldspathised portion of the dyke). But very low magnetic anomalies were observed in Dhaiya area (feldspathised portion of the dyke). While the non-feldspathised portion of the dyke is strongly magnetic, feldspathised portion is very feebly magnetic. Oriented specimens of the two types of rocks confirmed the field observations. Laboratory study of the oriented specimens shows that 80-90% of magnetization of the non-feldspathised rocks is due to remanence and the remaining due to induction. The magnetization of feldspathised rocks is nearly one-fifth that of non-feldspathised rocks. Magnetization of the dyke in the School campus is in the normal direction and has shallow dips. The declination varies from 37° West to 58° East of North. The magnetization of the dyke in Dhaiya is chiefly due to induction.

The remarkable change of magnetization of the portion of the dyke in Dhaiya appears to be connected with the feldspathisation of the rocks. A detailed study of the magnetic properties of these rocks and their petrography is in progress and the results will be published elsewhere in due course.

Thanks are due to Prof. N. L. Sharma for his keen interest in these studies.

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A NOTE ON THE EGGS AND LARVA OF *DINEUTES INDICUS* AUB. (COLEOPTERA—GYRINIDAE)

THE metamorphosis of aquatic Coleoptera has been a subject of considerable investigation in recent years.²⁻⁴ It is of special interest in view of the recent report² on the embryonic cuticle shed by the larvæ of some Dytiscidæ. Information in development of Gyrinidæ is very fragmentary and limited to very old accounts.² The family Gyrinidæ presents one of the most remarkable larval forms with their special adaptation to aquatic life. The most striking feature of these larvæ is that they are apneustic. The following is a preliminary note and constitutes the first description of the structure of the egg and the larva of *Dineutes indicus* Aub.

Copulations were observed from 10th July until 5th of October both in the laboratory and in the field. The period of copulation on average appears to be 35 minutes and the least time taken by a pair is 10 minutes. The eggs are laid singly and in rows. The minimum number of eggs laid by a single female is 30 while the maximum number so far counted is 90 only. Each egg is affixed to a substratum by gelatinous substance which hardens within a few hours. Just after the oviposition the eggs are cylindrical but as the embryo develops they become broadly oval or subspherical. The average size of the egg is 1.8 mm. in length and .7 mm. in breadth. The chorion has a characteristic hexagonal sculpturation. The vitelline membrane can be observed due to the fragile and translucent nature of the chorion.

Hatching takes place within 12 to 15 days at temperature 29° C. The chorion always splits lengthwise over the mid-dorsal line when the hatching is imminent. The empty egg shells show a single split starting from the cephalic pole almost to the posterior pole. Hatching has been observed under binocular microscope but the presence of provisional cuticle has not been noticed so far.

The freshly hatched larva is pale, transparent and measures on average about $4.5 \pm .5$ mm. in length. Compared to the larvæ of *Gyrinus* these are very small in size. The larva is elongated and conspicuously segmented. The head is larger than the prothorax. Eyes are situated laterally. The antennæ are four-segmented, the apical segment being the longest. The mandibles are large, pointed and perforated by a sucking canal. The labial and maxillary palps are four-jointed. Each leg is

1. Q. J. Geol. Min. Met. Soc. of India, 1950, 22, 11.

provided with paired claws and a conspicuous spine.

Each of the first eight abdominal segments carries a pair of plumose tracheal gills and the ninth has two pairs of similar organs. The tenth abdominal segment which appears to be inconspicuously divided bears posteriorly two pairs of long, cuspidate and cheliform spines. Their exact function has not been as yet ascertained. In addition to the above structures the tenth segment has two pairs of curved pygopods (see Fig. 1).

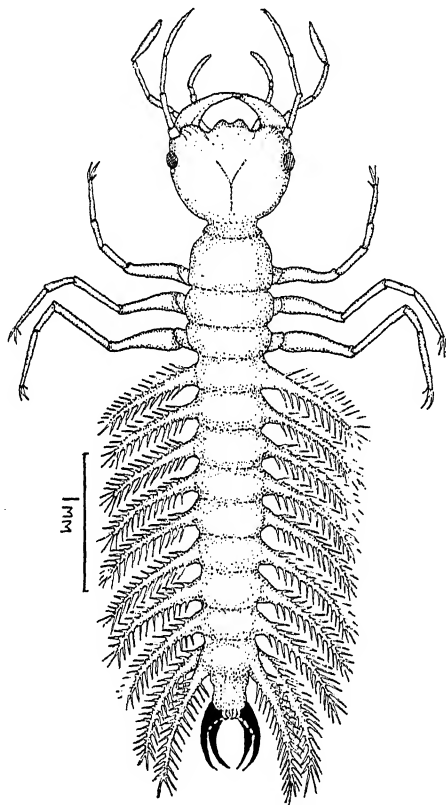


FIG. 1. Dorsal view of the freshly hatched larva of *Dineutes indicus* Aub.

The above brief account shows that the larva of *Dineutes* differs appreciably from that of *Gyrinus*, the limited descriptions of which are available.

Acknowledgement is due to the Ministry of Education, Government of India, for the award of a National Research Fellowship during the tenure of which this note is prepared. I am also grateful to the Director, M.A.C.S. Laboratory, for extending the necessary facilities.

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UTILISATION OF MAHUA CAKE AS MANURE

OF the methods which have been tried to utilise mahua cake as manure, none has met with complete success in making its nitrogen nitrify easily in the soil.^{5,8} The presence of saponins has often been quoted as the cause of defective nitrification of the cake in the soil.^{3,4,7} The cake is available annually in large quantities (about 30,000 tons) and practically no use is made except for fuel purposes. It was, therefore, thought desirable to investigate if extraction of the cake with suitable solvents could increase its nitrification in the soil.

The results (Table I) show that the cake can be nitrified to an extent of 18% during a

TABLE I
Nitrification of mahua cake and yield of cheena
in Delhi soil

Treatment	Rate of nitrification (mg. per day*)	% nitrogen nitrified in three months	Average yield of cheena per pot (g.)
Control	.. ..	..	0.24
Mahua cake (unextracted)	.. ..	2.50	0.20
Mahua cake extracted with water ..	.. ..	..	0.26
Mahua cake extracted with ether ..	0.049	10.00	0.58
Mahua cake extracted with alcohol	0.062	18.00	0.78
Mahua cake extracted with benzene	0.047	10.00	0.85
Mahua cake extracted with ether, benzene and alcohol ..	0.098	24.00	1.08

* Calculated from correlation between nitrate found in the soil and period in days.

period of three months by fractionally extracting it with alcohol and that such extracted cake gives an yield of cheena (*Panicum miliaceum*) several times that of the control. Extraction of the cake is possible in the modern solvent extraction plants which are coming in vogue in the country. The cost of alcohol used can be met with the extra amount of oil recovered (10%).

Detailed results of the investigation are being published elsewhere.

Indian Agricultural Research V. K. MISRA.
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OCCURRENCE OF *ANCHIOVELLA* *BAGANENSIS* HARDENBERG OFF EAST COAST OF INDIA

IN our studies on *Anchoviella* spp.¹ from various areas along the East Coast of India, we have come across a new species (for Indian waters), *Anchoviella baganensis* Hardenberg, from the Andhra Coast. Hardenberg² who first reported the species from Indonesian waters, divided it into two subspecies, *A. baganensis baganensis* and *A. baganensis macrops*, based on the diameter of the pupil, colour of the caudal fin, length of anal fin, number of gill rakers, and the number of vertebrae. This subdivision was substantiated by Delsman³ from the nature of the planktonic eggs. Hardenberg further suggested the existence of two distinct races in *A. baganensis baganensis*, differing from one another in the number of gill rakers.

The distinguishing characters of the species under study are:—

(1) High and compressed body. (2) Presence of a small but distinct spine in front of the dorsal fin. (3) Two thin but distinct lines of small black pigment spots on the back from dorsal to caudal. (4) Maturity reached at a length of about 6 cm. (5) Ovarial egg oval, without knob. Characters 1-4 help to distinguish the species from *A. tri*.

Of the 70 specimens obtained from Kakinada, 38 forms correspond to *Stolephorus (Anchoviella) baganensis baganensis* Hardenberg; the remaining 32 forms, and the 53 specimens obtained from Waltair differ markedly from either of the subspecies reported by Hardenberg, and may

have to be considered as forming a distinct and new subspecies.

The following are the main meristic characters

Character	Range
1. Pectoral f.r.	.. 11-14
2. Dorsal f.r. (excluding spine)	.. 14-17
3. Anal f.r.	.. 19-23
4. Gill rakers (lower arm)	.. 22-28
5. Vertebrae	.. 38-41

These two subspecies obtained by us can be easily distinguished externally, and the meristic characters confirm this separation.

External characters of the two subspecies

A	B
<i>A. baganensis baganensis</i>	<i>A. baganensis subsp. nov.</i>
1. Specimens are pale cream in colour, and covered with scales that are retained even after preservation	1. Specimens are relatively darker with scales that fall off easily on preservation
2. The pigment lines from dorsal to caudal are not so dark as in B	2. The two pigment lines are jet black
3. Delicate pigmentation on the back from head to dorsal	3. Such pigmentation almost absent
4. Maturity is reached even before attaining a total length of 6 cm.	4. Maturity reached only after 6 cm.

Meristic characters of the two subspecies

Character	<i>A. baganensis baganensis</i> n 38	<i>A. baganensis subsp. nov.</i> Kakinada n 32	Waltair n 53
1. Dorsal f.r. (excluding spine)	14-79	15-50	15-66
2. Anal f.r.	.. 21-42	20-72	20-29
3. Gill rakers (lower arm)	26-21	23-60	23-28
4. Vertebrae	.. 38-79	39-78	39-54

The differences between the Kakinada and Waltair forms of the new subspecies are not statistically significant, and may be attributed to geographical variation. The differences in the means of the gill rakers and vertebrae of the two subspecies are particularly noticeable.

The name *Anchoviella baganensis bengalensis* is proposed for the new species in view of its

first being reported from the Bay of Bengal.

Details will be published elsewhere.

Dept. of Zoology, S. DUTT.
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**ON THE BIOLOGY OF APANTALES
OBLIQUA (WILK.), A LARVAL
PARASITE OF DIACRISIA OBLIQUA
(WLK.)**

Diacrisia obliqua (Wlk.), belonging to the family *Arctiidae* is some times very destructive to pulses, vegetables and fibre crops in Bihar. Field survey on this pest revealed that a certain percentage of the caterpillars of this insect were found parasitized by *Apantales obliqua* (Wilk.).

Wilkinson (1928) first described the species *Apantales obliqua* while revising the Indo-Australian species of the genus *Apantales*. Beeson and Chatterjee (1935) recorded it as a parasite on the caterpillars of *D. obliqua*, *Amsacta* spp. and on other *Arctiidae* in the Punjab and Dehra Dun. Bhatnagar (1948) studied and described the morphology of the head and thorax of *Apantales obliqua*. With a view to study the potentiality of this parasite in the biological control of *D. obliqua*, preliminary studies on the biology of the parasite were carried out.

A stock culture of this parasite was successfully maintained in the insectory during the period from August to February 1957-58. On emergence of the adult parasites from the cocoons, the male and female parasites were separated and each pair was confined in a test tube with mouth covered with thin muslin for allowing aeration and with a layer of moist sand at the bottom. A known number of laboratory bred second instar caterpillars of *D. obliqua* along with a small piece of green castor leaf were introduced in each test tube for parasitization. The caterpillars were left with the parasites during the day and were transferred to wire-gauze cages in the evening and fed with fresh green leaves each day till their death. The parasitic cocoons obtained from these caterpillars were separated and transferred to separate test-tubes.

The adults of *Apantales obliqua* were found to mate within 10 to 12 hours after emergence,

after which the female parasites usually search for suitable larvæ for oviposition. As soon as a suitable host is located, the female parasite approaches the host larva by bending her body at a right angle and inserts her ovipositor through the larval cuticle for oviposition. One female parasite was found to lay eggs in the same host for more than once. First and second instar caterpillars of *D. obliqua* were preferred by the parasite for oviposition. Examination of the freshly infected larvæ revealed that 10-15 eggs were deposited at a time by a female parasite. Five to seven depositions were usually made by a female parasite inside the larval cuticle of the same larva or different larvæ before her death. The minimum number of caterpillars parasitized by single female parasite during her life-time was 8 while the maximum number was 15. The total number of cocoons obtained from 8 and 15 parasitized caterpillars were 55 and 91 respectively. The total number of eggs laid by a female parasite during her life-time varied between 61 to 103 eggs. In the laboratory, the longevity of the adult female parasite ranged between 3 to 7 days.

The freshly laid eggs are spindle-shaped, creamy white and smooth and measure about 0.04 mm. On hatching, the parasitic larvæ feed on the lymph and fatty tissues of the host and complete their larval development inside the body of the host. When full grown, they exit through the ventro-lateral body region of the host larva. The parasitic grub is yellowish white and possesses lateral protuberances on either side of its body and measure about 5 mm. in length. A thin bladder-like appendage about 0.5 mm. in length is present at the posterior end of the last abdominal segment. Immediately after exit from the host, each grub begins to spin a white silken cocoon round itself and soon a compact mass of milky white cocoons appear on the sides of the host larva. All the parasitic grubs usually do not make their exit from the body of the host in one day but continue to exit for 2 to 3 days. The pupa inside the white cocoon is brownish grey in colour and measures about 4 mm. in length. The adult emerges by cutting a circular lid at the end of the cocoon. The total duration of the life-cycle was 16.2 days during February to March and 24.5 days during November to January.

The percentage of parasitization in the caterpillars of *D. obliqua* ranged between 5.27 to 19.63 in the field during August to March and was found to be highest during the month of November. The parasitic cocoons collected from

the field during the month of February failed to produce adults till next July which evidently indicates the possibility of the parasite aestivating in the pupal stage inside the cocoon during summer months.

In literature, there is no information available on the biology of *Apantale obliqua*. The findings of this paper, bring to light two significant facts on the biology of *A. obliqua*: firstly, the high biotic potential of the female parasite and secondly, the ability to aestivate in the pupal stage during summer months in Bihar. Further studies on the factors controlling aestivation and active phase of the parasite are still in progress.

The author wishes to express his gratitude to Dr. R. H. Richharia, Ph.D. (Cantab.), Principal, for providing necessary facilities in the Post-graduate Laboratory for carrying out the investigations.

Division of Entomology, B. S. LALL.
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CHROMOSOME STUDIES IN SOME MEMBERS OF CHILOPODA (CLASS : MYRIAPODA)

THE Chilopoda is represented by a number of genera and species with wide distribution but the cytology of the group has received scant attention. Ogawa¹⁻⁶ has studied the chromosome number in eight species belonging to six genera: *Scolopendra subspinipes mutilans* ($2n: 28$); *Scolopendra s. japonica* ($2n: 18$); *Otocryptops rubiginosus* ($2n: 27$); *Otocryptops sp.* ($2n: 22$); *Bothropyls asperatus* ($2n: 38$); *Esastigmatobius longitarsis* ($2n: 20$); *Thereuonema hilgendorfi* ($2n: 36$); and *Thereupoda clunifera* ($2n: 36$). He describes a clear case of XY-type of sex-mechanism in the males of the genera *Thereuonema* and *Thereupoda* and presumes the existence of an XO-mechanism in the males of *Otocryptops rubiginosus*. In regard to the Scolopendridae, Ogawa⁴ observes that the sex-chromosome mechanism is unknown. According to Makino and Niiyama⁷ the diploid number in *Scolopendra damnosa* is 28 but here again the sex-chromosome mechanism is unknown. The present note embodies observations made on the number and structure of the chromosome, germinating seedlings of loquat, however,

nature of the kinetochore and sex-chromosome mechanism in some Indian Chilopods.

Nine species belonging to six genera and three families have been investigated (see Table I). In all cases the sex-chromosome mechanism is of the XY-type in the male. There is a localised kinetochore.

TABLE I

Species	Chromosome number	
	$2n$	n
Sub-order: Scolopendromorpha		
Family: Scolopendridae		
1. <i>Scolopendra morsitans</i> Linn.	24	12 (I, II)
2. <i>Rhysida lithobioides</i> Newport	18	9 (I, II)
3. <i>Rhysida nuda</i> Newport	18	9 (I, II)
4. <i>Rhysida sp.</i>	16	8 (I, II)
5. <i>Cormocephalus pygmaeus</i> Pocock	20	10 (I, II)
6. <i>Ethmostigmus sp.</i>	18	9 (I, II)
Sub-order: Geophilomorpha		
Family: Geophilidae		
7. <i>Mecistocephalus punctifrons</i> Newport	26	13 (I, II)
Sub-order: Scutigeromorpha		
Family: Scutigeridae		
8. * <i>Scutigera sp.</i>	36	18 (I, II)
9. * <i>Scutigera sp.</i>	36	18 (I, II)

* The two species differ in their ecology, colour and body-size.

The details of spermatogenesis of the forms included in this study will be published elsewhere.

My sincere thanks are due to Prof. B. R. Seshachar, Department of Zoology, Central College, Bangalore, for his criticism and encouragement and to the Ministry of Education, Government of India, for the award of a Senior Fellowship.

Department of Zoology, C. R. PUTTANNA.
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EMBRYONY IN LOQUAT (*ERIOBOTRYA JAPONICA* LINDL.)

POLYEMBRYONY has been recorded in the fruit plants like *Citrus* spp., *Mangifera* spp., *Poncirus trifoliata* Raf. and *Syzygium* spp.³ It has also been reported in loquat.¹ Observations of the

showed no such phenomenon. It was, therefore, decided to study the occurrence, extent and varietal response of different loquat cultivars to polyembryony.



FIG. 1

The cultivated varieties taken for this study were Golden yellow, Improved golden yellow, Pale yellow, Improved pale yellow, Fire ball, Large Agra, Long white, California advance, Tanaka and Hord's mammoth. Fifty seeds from each of these varieties were dissected to find out the number of embryos present in the seed and

TABLE I

Number of multiple shoots in different cultivars of loquat

Sl. No.	Cultivars	No. of seeds germinated out of 100	Number of plants having multiple				% of seeds showing multiple shoots
			2 shoots	3 shoots	4 shoots	5 shoots	
1	Golden yellow ..	82	7	4	1	1	15.85
2	Improved golden yellow ..	80	7	1	0	0	10.00
3	Pale yellow ..	76	5	3	0	0	10.53
4	Improved pale yellow ..	93	6	4	1	0	11.83
5	Fire ball ..	81	16	5	1	2	29.63
6	Large Agra ..	69	10	3	0	0	18.84
7	Long white ..	75	0	0	0	0	00.00
8	California advance ..	85	6	3	0	0	10.59
9	Tanaka ..	67	3	1	0	0	5.97
10	Hord's mammoth ..	94	13	10	1	0	25.53
Average ..		80.2	7.3	3.4	0.4	0.3	13.877

the other lot of 100 seeds each was sown in pots to detect multiple seedlings, if any. None of the dissected seeds showed more than one embryo, which was further manifested in the production of single gametic seedlings from a seed. A number of germinating seedlings, however, showed multiple shoots, a phenomenon also reported in case of Indian mangoes (*Mangifera indica* L.).⁴ The plants exhibiting multiple shoots had only one root while for polyembryonic seedlings there should be as many roots as there are shoots. The frequency of such shoots is given in Table I.

Table I shows that on an average only 13.87% seedlings showed multiple shoot formation. Long white variety exhibited no such phenomenon while the Fire ball variety had the maximum percentage (29.63).

Thus, contrary to the observations of Bajpai,¹ the present studies show that there is no polyembryony in loquat.

ACKNOWLEDGEMENT

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Horticultural Research Institute,
Saharanpur,
October 17, 1958.

UDAY PRATAP SINGH.

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CYTOLOGY OF SOME HIMALAYAN MOSSES

IMPORTANT cytological contribution on wild populations of various Finnish,^{1,2} North American,³⁻⁵ Japanese⁶⁻⁸ and British⁹ mosses have appeared in recent years. But no such account exists for the Indian mosses except a few fragmentary reports. With this in mind the present study was undertaken with particular reference to the family Pottiaceae, one of the well represented moss families in the Himalayas. The material was studied at meiosis during the monsoons of the years 1956-57 at Mussoorie

(6,500 ft. W. Himalayas) following the usual acetocarmine squash technique. Though a larger number of the species have been worked out the present report (Table I) contains only those for which no previous cytological record is available.

TABLE I

Name of the species	Meiotic chromosome number
DICRANACEÆ :	
1. <i>Dicranella emodi-varia</i> C. Müll...	15
2. <i>D. mollicula</i> (Mitt.) Jaeg. ..	15
3. <i>Trematodon capillifolius</i> C. Müll.	15
POTTIACEÆ :	
*4. <i>Molendia roylei</i> (Mitt.) Broth...	13
5. <i>Barbula flavescent</i> (Hook. & Grev.) Brid.	13
6. <i>B. constricta</i> Mitt. ..	13
7. <i>B. ehrenbergi</i> (Lor.) Fl. ..	13
*8. <i>Gymnostomum calcarum</i> Nees & Horn.	13
9. <i>G. recurvirostrum</i> Hedw. ..	13
10. <i>G. aurantiicum</i> (Mitt.) Par. ..	13
*11. <i>Hymenostyphnum curvirostre</i> (Ehrh.) Lindb.	13
*12. <i>Reimersia inconspicua</i> (Griff.) Chen	13+f
*13. <i>Anactargium thomsonii</i> Mitt. ..	13
14. <i>A. strachythecianum</i> Mitt. ..	13
*15. <i>Brachythecium phyllum atrorubens</i> (Besch.) Chen	13+f
16. <i>B. wallchii</i> Mitt. (Chen) ..	13
17. <i>Timmia anomala</i> (B. & S.) Schimp	15
*18. <i>Hyophila involuta</i> (Hook.) Jaeg.	13
*19. <i>Merceya gedana</i> (Lac.) Noguchi	13
20. <i>Weisia crispata</i> (Hedw.) Mitt. ..	13
GRIMMIACEÆ :	
21. <i>Grimmia commutata</i> Huebn. ..	13
BARTRAMIACEÆ :	
22. <i>Bartramia subpellucida</i> Mitt. ..	8
23. <i>Philonotis heterophylla</i> Mitt. ..	6
24. <i>P. graffthiana</i> (Wils.) Mitt. ..	6
LEUCODONTIACEÆ :	
25. <i>Leucodon secundus</i> (Harv.) Mitt.	9

The report of the chromosome number for 8 genera marked * and all the species appears for the first time.

A detailed account concerning cytotaxonomy, behaviour and properties of sex and accessory chromosomes, polyploidy, etc., will be presented elsewhere.

The writer is deeply indebted to Prof. P. N. Mehra for valuable criticism and many useful suggestions and Messrs. R. S. Chopra and T. N. Khoshoo for their keen interest in the work. He is also thankful to Mr. A. H. Norkett of the

British Museum, London, for the help with the identification of the specimens.

Botany Department,
Panjab University,
Amritsar, India,
September 27, 1958.

K. R. KHANNA.

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OCCURRENCE OF FASCIATED FRUITS IN CAPSICUM

A CASE of three fruits arising from a common pedicel was spotted by the author during 1957 in Kurnool District in a stunted *Capsicum annuum* plant. There is a common stalk and a common cup-shaped calyx as in the case of normal fruits but with three separate fruits attached to this stalk. The dried up pedicel showed distinct strands indicative of fasciation.

In *Capsicum annuum* also, cases of two fruits occurring at a node have been recorded. There is also a bunch mutant reported. This freak may be one of fasciation of three fruits in a bunch type. The seeds have been extracted to raise the progeny to find out whether the parent was a bunch-mutant.

Agricultural Research Station,
Nandyal R.S. & P.O.,
September 25, 1958.

ARGINA CRIBRARIA CLERCK, A PEST ON SUNNHEMP IN MADRAS STATE

Argina cribraria, Clerck (Fam. Hypsidæ, Lepidoptera),¹ is a caterpillar pest which does extensive damage to Sunnhemp (*Crotalaria juncea*) in Madras State. About three broods were noted during the duration of the crop, June to November, in the field. Lefroy (1909) mentions it as a serious pest feeding mainly on the leaves of *Crotalaria juncea*. It has since been found to have a number of other host plants such as *Crotalaria serica*, *C. salitana*,

C. retusa, *C. anagyroides* and *Calapagonium corensis*. In severe cases of attack, leaves, pods, and flowers are eaten away.



FIG 1. Life-history stages of *Argina cribraria*, Clerck.
(a) Egg. (b) Caterpillar. (c) Pupa. (d) Adult.

Life-history.—Eggs are laid in small clusters on the undersurface of leaves. The larva passes through five instars and pupates at its sixth moult. The larval period lasts 18 to 21 days. Pupation takes place on the plant or on the surface of the soil. The pupal period ranges from 6 to 7 days. The total life-cycle is about 26 to 31 days.

The results of trials with synthetic chemicals to control the pest clearly indicated that the pest could be effectively checked either by dusting 5% BHC or spraying 0.1% Dieldrin.

The author wishes to express his gratitude to the Government Entomologist for facilities afforded during the investigation.

Agricultural Department. S. VENUGOPAL.
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OCCURRENCE OF CYTOPLASMIC MALE-STERILITY IN PEARL MILLET (*Pennisetum typhoides*) STAPP AND HUBB.)

VARIED manifestations of the influence of cytoplasm in heredity have been revealed by recent investigations.^{2,5,6} Cytoplasmic male-sterility has been reported in different plants and it has been found to be a useful tool for

the plant breeder in the large-scale production of hybrid seed in crops where heterosis is exploited for improvement of yield.³

Among the collection of varieties of pearl millet studied at the Millet Breeding Station, a high frequency of male-sterile plants was observed in 1949, in open-pollinated populations of one, viz., P.T. 819 (Sajja from Bellary District, Mysore State, India). The male-sterile plants had underdeveloped anthers, which contained only an agglutinated mass of empty pollen. They failed to dehisce and dried up much earlier than the normal fertile ones. No meiotic abnormalities were observed in the P.M.C.s. In selfed panicles of male-sterile plants there was no seed-setting, while in open-pollinated or artificially pollinated panicles seed-setting was full indicating complete fertility of ovules.

Choosing male-sterile plants from P.T. 819 as female parents, seven crosses were effected in 1950, with pollen collected from single plants of inbred lines breeding true for male-fertility and unrelated to P.T. 819, and also from fertile plants of P.T. 819. Of the four crosses with unrelated pollen parents, two gave only male-sterile plants in the progeny, while in the other two, segregation for fertile and male-sterile plants was observed. The progenies of the three crosses with fertile plants from P.T. 819 segregated male-sterile and fertile plants. The F_1 plants of the families which gave only male-sterile progeny (P.T. 819 Male-sterile \times P.T. 732/5 and P.T. 819 Male-sterile \times P.T. 837/7) were backcrossed to single plants of normal true-breeding fertile inbred lines unrelated to P.T. 819. The progenies of these 22 backcrosses were interesting in that 13 of them showed only male-sterile plants, while two had only fertile plants and the other seven segregated male-sterile and fertile plants in a 1 : 1 ratio.

The behaviour of some of these backcross progenies in giving only male-sterile plants or only fertile plants pointed to the cytoplasmic influence in the inheritance of male-sterility. Reciprocal crosses were, therefore, effected between fertile plants of P.T. 819 and the true-breeding fertile inbred line P.T. 732/5 which gave only male-sterile progenies in backcrosses with male-sterile plants. The individuals involved in each cross were used both as male and female parents, taking advantage of the tiller panicles, so as to avoid the differences that might arise due to the heterogeneity of the parental populations. The progenies as indicated in Table I clearly demonstrated the reciprocal differences.

TABLE I

Female parent	Male parent	No. of families	Progeny		
			Fertile	Male-sterile	Total
P.T. 732/5 (Fertile)	× P.T. 819 (Fertile)	6	1020	..	1020
" 819	× " 732/5	6	474	460	934
" 732/5	× " 819	1	114	..	114
" 819	× " 732/5	1	100	..	100

For confirmatory evidence, one of the male-sterile cultures [P.T. 819 (male-sterile) × P.T. 732/5] was continuously backcrossed to its fertile male parent, P.T. 732/5 with a view to effect gene substitution. The backcrossing was done in successive years from 1951, selection being exercised in the progeny for paternal characteristics. Their behaviour in successive generations is given in Table II.

TABLE II

Backcross generation	No. of families	Progeny			Total
		Fertile	Partially male-sterile	Male-sterile	
I	1	..	..	89	89
II	1	..	..	75	75
III	2	..	..	54	54
IV	7	..	..	591	591
V	6	..	8*	512	520

* Observed only in two families.

The persistence of male-sterility in all the plants of the different progenies after continued backcrossing (except for the very few partially male-sterile plants with occasional fertile anthers amidst sterile ones, observed in two families in the fifth generation), was conspicuous, even though in most other morphological characteristics the backcrossed plants resembled the male parent. It was thereby clear that the nuclear genes contributed by P.T. 732/5 were ineffective in producing pollen fertility in plants with cytoplasm derived from P.T. 819, which is specifically different from that of P.T. 732/5 and maintained its characteristic in spite of substitution of the nuclear genes of P.T. 732/5.

It was, however, seen that in some of the backcrosses of the male-sterile F_1 to true breeding fertile inbred parents, complete restoration of fertility occurred, while others segregated male-sterile and fertile plants.

These simple segregations indicate that the male parents used in the backcrosses were heterozygous for a major nuclear gene, the dominant allelomorph of which could restore fertility in P.T. 819 cytoplasm. These facts are also borne out by the reciprocal crosses wherein segregation into male-sterile and fertile plants was observed in progenies having P.T. 819 as female parents. The nature of action of the nuclear genes of P.T. 732/5 in P.T. 819 cytoplasm being evident from the continued backcrosses, the segregation in the progeny of these reciprocal crosses should have resulted from the heterozygosity of the female parents for fertility restorer factors. If inheritance of the character was solely controlled by nuclear factors, the progenies of the reciprocal crosses should have been identical and if nuclear genes had no effect, the segregation of fertile and male-sterile plants in the backcrosses could not have been noticed. It is, therefore, evident that the male-sterility observed in P.T. 819 is dependent on an interaction between nuclear and cytoplasmic factors. The differential action of the genes is expressed in the phenotype, only in the P.T. 819 cytoplasm, but not in the cytoplasm of other fertile true-breeding inbred lines derived from unrelated varieties like P.T. 732/5.

The utilization of cytoplasmic male-sterility in the breeding programme for the exploitation of heterosis in the pearl millet can obviate the limitations experienced in the large-scale production of hybrid seed by the methods in vogue. Kajjari and Patel⁴ described a male-sterile plant but presented no evidence as to the mode of inheritance. Recently, however, Burton¹ reported the occurrence of male-sterile plants in crosses between inbred lines of this millet and suggested the mode of inheritance to be cytoplasmic. Successful use of the male-sterility described above is being made by continuous backcrossing to some superior inbred lines maintained at the station. The existence of a good number of inbreds with fertility restorer genes is a highly favourable factor. Detailed investigation on these aspects has been progressing and will be reported elsewhere.

Millet's Breeding Station, P. MADHAVA MENON.
Agricultural College and
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CONTROL OF CITRUS CANKER WITH ANTIBIOTICS

THE effect of streptomycin sulphate in controlling canker disease of citrus, caused by *Xanthomonas citri* (Hasse) Dowson, is being reported elsewhere by the authors.¹ The antibiotic when sprayed in aqueous solutions at 500 and 1,000 p.p.m. together with 1% glycerin was found to be absorbed within eight hours by the leaves and persisted in the tissues up to 21 days. Spraying the chemical at 15-day intervals checked the disease spread on three-year old acid lime [*Citrus aurantifolia* (Christm.) Swingle] plants. In the present communication results obtained from subsequent field tests carried out to compare more antibiotic preparations for controlling citrus canker are reported.

The experiment was laid out in a commercial orchard in Pinnalpur, South Arcot District. A block of 48 five-year old acid lime plants was selected for the purpose. The plants were treated by randomized replicated experimental design, with six treatments and eight replications. The samples of Phytomycin, an agricultural spray material containing 20% streptomycin nitrate as active ingredient, which has been reported to be effective against several bacterial diseases of crop plants in U.S.A.,²⁻⁴ and Thiostrepton, another antibacterial antibiotic, were obtained from the Squibb Institute for Medical Research, New Brunswick, N.J., U.S.A. A pharmaceutical grade of streptomycin sulphate with 740 units/mg. (Glaxo Laboratories) was used in the experiments. 1% Bordeaux mixture was prepared in the usual manner and sprayed for comparison. The methods of recording and evaluation of disease intensity were essentially the same as was detailed earlier.¹ The chemicals were sprayed in aqueous solutions with 1% glycerin, using a Primus sprayer, at fortnightly intervals. Infection counts were taken prior to each spraying and the results are represented graphically in Fig. 1.

At the commencement of the experiment,

early in August, there was severe canker infection on the plants, but soon after there was heavy reduction in the disease intensity in all plants

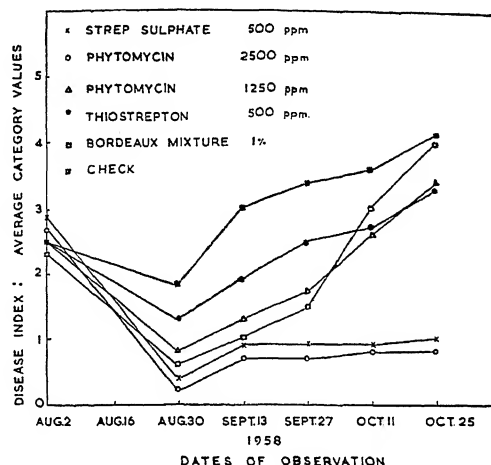


FIG. 1. Effect of antibiotics on citrus canker: Disease incidence expressed as category values.*

* Grading and category values used are: No infection = 0; 0-10% = 1; 10-30% = 2; 30-50% = 3; 50-75% = 4; > 75% = 5.

S.E. 0.34
C.D. at 5% level 0.67

due to leaf drop. With the new flush by the end of August the disease started spreading rapidly in the orchard. Among the treatments, Phytomycin† (2,500 p.p.m.) and streptomycin sulphate checked down considerably the progress of the disease, while the others were not much effective (Fig. 1). In the case of Bordeaux mixture spray, there was initial heavy reduction in disease intensity due to leaf drop, but subsequent growth of new flush was arrested for some period. When the new flush was on in September-October the disease became almost as severe as in the check plants.

The authors are thankful to Messrs. Squibb and Son, for the supply of Phytomycin and Thiostrepton used in these studies.

Dept. of Agriculture, G. RANGASWAMI.
Annamalai University, RAO RAMA RAO.
Annamalainagar (S. Arcot), AR. LAKSHMANAN.
November 18, 1958.

† Phytomycin at 1,250 p.p.m. however did not have any effect.

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SIMARUBACEOXYLON MAHURZARI
GEN. ET SP. NOV., A NEW FOSSIL
WOOD FROM THE DECCAN INTER-
TRAPPEAN BEDS OF MAHURZARI

THE present note deals with a fossil dicotyledonous wood from the Deccan Intertrappean beds of Mahurzari, a village about 8 miles from Nagpur. Large number of pieces of petrified dicotyledonous woods have been collected from this locality.

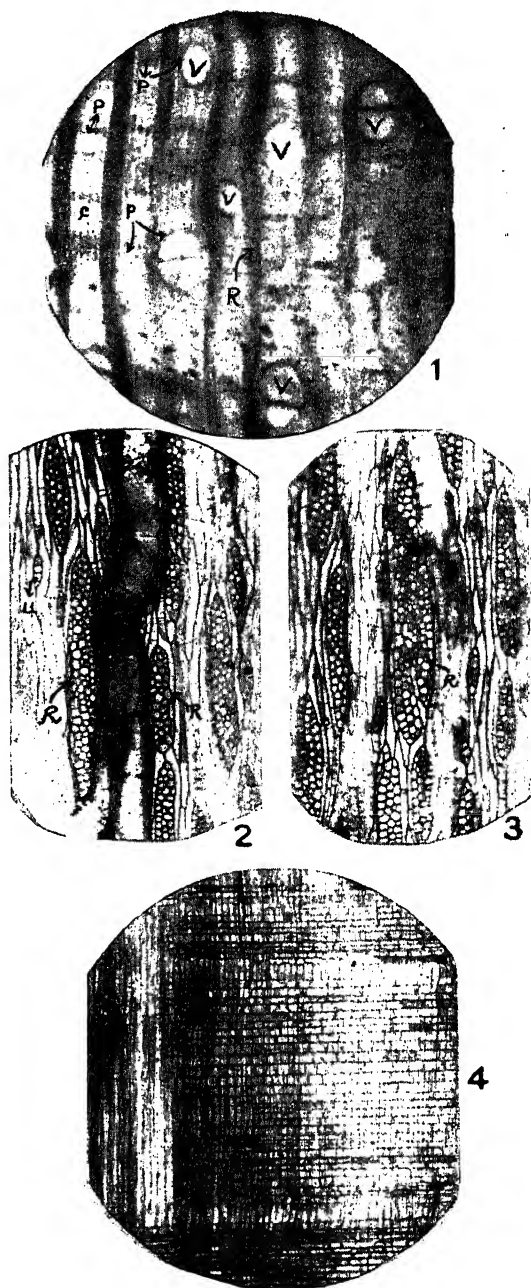
The present specimen is a big silicified piece of secondary wood with fairly good preservation. The natural reddish stain of the petrifications made the study of the wood easy.

It is medium coarse textured and distinctly diffuse porous wood; growth marks faint. Vessels visible when seen with hand lens; medium-sized, the radial and tangential diameters being 150 to 200μ and 100 to 150μ respectively; evenly distributed; solitary or in radial rows of two (Fig. 1); usually filled with tyloses. Intervessel pits alternate and bordered (Fig. 2). Parenchyma fairly abundant about the pores, lateral extensions present (Fig. 1). Rays broad to fine; the broad rays conspicuous, homogeneous (Fig. 4) consisting of procumbent cells of various sizes (Figs. 2, 3, & 4); 2 to 7 cells and 50 to 150μ in width and 1 to 70 cells and 60μ to $1,600\mu$ in height; the fine rays uniseriate, again homogeneous, made up of procumbent cells (Fig. 2), interspersed with broad rays. Fibres non-libriform, somewhat angular in cross-section with fairly large lumen, non-septate with bordered pits.

Comparisons of the fossil wood are drawn up with dicot families Rutaceae and Simarubaceae. There is no outstanding feature in the fossil wood which, if considered alone, would help in its identifications. The author has therefore adopted a well-known method of taking the combination of characters and going through all the dicot families. The combination of characters is well met in family Simarubaceae. The comparisons are drawn up with two living genera, *Ailanthus* and *Simaruba*¹⁻² in particular. Further investigations on the generic identification of the fossil are being carried out and results will be published later.

A form genus has been established to accommodate the fossil. The name *Simarubaceoxylon* has been used in the sense that the fossil wood belongs to family Simarubaceae.

I am indebted to Dr. (Mrs.) S. D. Chitale of College of Science, Nagpur, Shri S. S. Ghosh and Shri M. H. Kazmi of Forest Research Institute,



FIGS. 1-4

FIG. 1. Transverse section showing distribution of vessels (V), rays (R) and parenchyma (P), $\times 45$. FIGS. 2 & 3 Tangential sections showing ray characteristics (K). Note the uniseriate ray (U) in Fig. 2. $\times 45$. FIG. 4. Radial section showing clearly the homogeneous condition of the rays, $\times 45$.

Dehra Dun, and Shri B. G. L. Swamy for their valuable guidance and helpful suggestions.

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SEED-LEAF INJURY DURING GERMINATION IN COTTON

CLOSE observations on three week old seedlings in a bulk crop of MCU—2 cotton on the Cotton Research Farm, Srivilliputhur, Madras State, during 1957, showed that in 18 out of a random sample of 100 seedlings the seed-leaf was not perfect in outline. One of the leaves showed signs of a mechanical injury at the margin corresponding to the place of final release from the grip of the ruptured testa shrinking in the process of germination. In most cases part of the white papery membranous relic of the endosperm was also found attached on the adaxial surface of the cotyledon. In stray cases a halo of anthocyanin developed along the fringe of the damaged tissue. This localisation of the injury would appear to be a case of traumatic response as a consequence of tardy disentanglement of the seed-leaf and a rapidly dehydrating testa. The injury was not due to entomological or pathological cause as one was apt to judge on cursory observations. It did not inhibit further development of the seed-leaf. This observation is let in to show that this is a new congenital defect which may show varietal incidence and as far as the authors are aware, it has not been recorded before in this country, or in any other country.

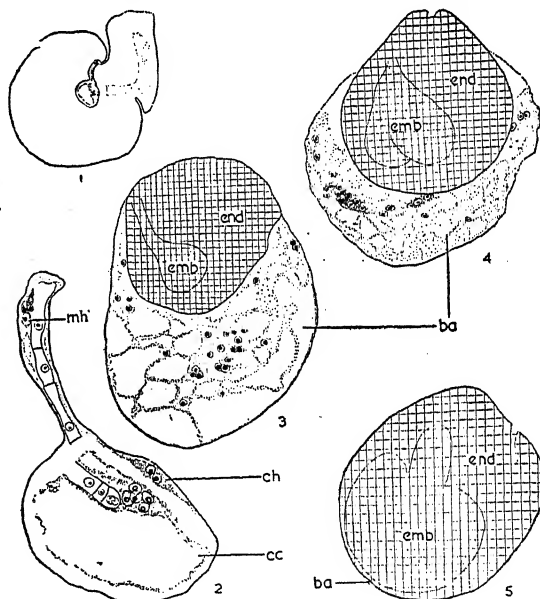
Madras Agricultural L. NEELAKANTAN.
Department, V. SIVASUBRAMANIAN.
Lawley Road,
Coimbatore,
October 9, 1958.

ENDOSPERM IN *ERANTHEMUM NERVOSUM*

THE mode of endosperm formation in the family Acanthaceae is unique. With the exception of *Thurbergia* (Mauritzon¹) all the acanthaceous plants so far investigated show an initial vertical row of three endosperm cells, also met with in some families of the Tubiflorae, like Hydrophyllaceae, Boraginaceae, Scrophulari-

aceae and Lobiateae. What characterises the development subsequent to the three-celled endosperm of the Acanthaceae in the stage? The central cell alone produces the endosperm proper, while the other two cells are transformed into the micropylar and the chalazal haustoria respectively. Usually the haustoria are unicellular and contain two or four nuclei. The endosperm proper may be nuclear to begin with but ultimately becomes cellular, or it may be cellular from its very inception. In several genera cell formation in the nuclear endosperm may be restricted to the part surrounding the embryo, leaving below it a free nuclear zone—the basal apparatus (Mauritzon¹, Mohan Ram², Mohan Ram and Sehgal³). The latter shows a great degree of variation in its extent and activity.

To start with, the central endosperm chamber in *Eranthemum nervosum* shows a free nuclear condition (Figs. 1, 2). According to Mauritzon,¹



Figs. 1 and 2 from microtome sections; Figs. 3–5 from dissected whole mounts.

FIG. 1. L.s. young seed, $\times 40$. FIG. 2. Embryo-sac enlarged from Fig. 1 showing a long pro-embryo, a two-nucleate chalazal haustoria and micropylar haustoria and a five-nucleate central chamber, $\times 550$. FIGS. 3–5. Later stages of endosperm. In Figs 3 and 4 a broad basal apparatus is observed. Fig. 3, $\times 180$, Fig. 4, $\times 80$ and Fig. 5, $\times 50$.

ba, basal apparatus; cc, central chamber; ch, chalazal haustorium;

emb, embryo; end, endosperm proper; mh, micropylar haustorium.

in *E. leuconeuron* it becomes completely cellular after the 16-nucleate stage without forming a

basal apparatus. However, in *E. nervosum* it is found that wall formation is postponed until 32-64 free nuclei are formed, and a distinct basal apparatus always surrounds the cellular part of the endosperm (Figs. 3, 4). This is especially clear in dissections made under a stereoscopic microscope.

It may be pointed out that microtomed sections of young seeds always show a large empty space around the cellular endosperm. This represents the basal apparatus which is eventually used up by the enlarging cellular endosperm (Fig. 5).

It seems probable that in *E. leuconeuron* also, a basal apparatus similar to that of *E. nervosum* is present. Mauritzon's failure to observe it appears to be due to studying microtome sections alone which tend to give an incomplete picture unless supplemented by dissections and whole mounts.

Prof. P. Maheshwari's suggestions are gratefully acknowledged.

Department of Botany, H. Y. MOHAN RAM.
University of Delhi,
December 3, 1958.

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THE OCCURRENCE OF A SYMPHYLID (CLASS: MYRIAPODA) AS A PEST OF SUGARCANE AT COIMBATORE

VARIOUS soil animals are known to damage roots of crop plants. Ingram^{3,4} reported the occurrence of *Hanseniella unguiculata* Bagnall, a symphyliid, along with certain other kind of soil animals in Louisiana sugarcane fields, causing root injury to sugarcane plants.

Spencer and Stracener^{1,2} observed extensive root injury to sugarcane by various soil organisms and demonstrated experimentally that root injury known as "Pitting" could be produced by the Symphyliid, *Symphylella* sp.

In the course of a search for soil pests responsible for the heavy mortality of sugarcane seedlings (30 to 40%) in flats at the Sugarcane Breeding Institute, Coimbatore, the author ran into large numbers of a white symphyliid in the soil surrounding the root zone of seedlings in the specially constructed brick flats on which the seedlings are raised. The examination of

the root system revealed root damage in the form of 'pits' on the roots. The symphyliids were actually seen to "gnaw" at the roots and tender root hairs (Figs. 1 & 2).



FIG. 1. Symphyliids *in situ*: Feeding on roots of sugarcane (arrows denote damaged portions of root).

FIG. 2. Roots of sugarcane showing fresh damage in the form of "pits".

As far as the author is aware, this appears to be the first record of a symphyliid affecting sugarcane in India. This is of particular importance to this Institute, which raises millions of hybrid sugarcane seedlings every year and which experiences a heavy loss of valuable seedlings in the nursery stage itself due to various factors including soil pests.

My thanks are due to Dr. N. R. Bhat, Director, and Shri R. A. Agarwal, Entomologist, for their keen interest in the work.

Sugarcane Breeding Institute, G. N. RAO.
Post Lawley Road,
Coimbatore,
November 1, 1958.

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A NEW SPECIES OF *CILIOCHORELLA*
ON *EUCALYPTUS GLOBULUS* L.

DURING the month of July 1958, the writer collected a fungus occurring as a saprophyte on dried leaves of *Eucalyptus globulus* L. On microscopic examination the fungus was identified as *Ciliochorella* which was first established by Sydow and Mitter (1935). Since this fungus was observed for the first time in the Bombay State and collected on a hitherto unreported host, a critical study was undertaken. A comparison between the Poona species of *Ciliochorella* and the type, *Ciliochorella mangiferae* Syd. as emended by Subramanian and Ramakrishnan (1956) is presented in Table I.

TABLE I

Species	Pycnidia (diameter)	Conidia	Lateral appendage	Basal appendage
	(mm.)			
<i>C. mangiferae</i> Syd.	up to 2	29-39 $\times 2.6-3.3 \mu$	11-20 μ	4-9 μ
Poona species ..	up to 1	8.5-18.7 $\times 1.7-2.6 \mu$	17-28 μ	3-9 μ

It is evident from a study of Table I that the Poona species is quite distinct from *Ciliochorella mangiferae* Syd. in several respects, possessing smaller pycnidia, and conidia and longer lateral appendages. The Poona species is, therefore, described as a new species of *Ciliochorella*.

Ciliochorella EUCALYPTI VISWANATHAN SPEC. NOV.

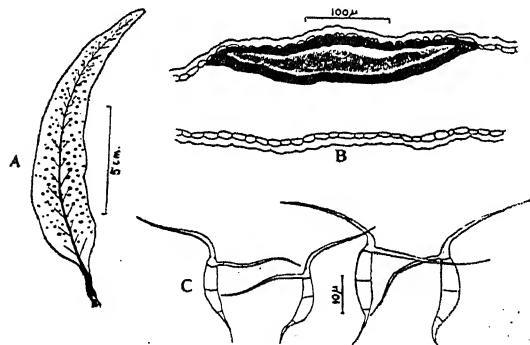


FIG. 1. A. leaf of *Eucalyptus globulus* L. showing infection spots. B. Section of pycnidium; C. Conidia.

Pycnidia amphigena, nigra, circularia, dispersa, dimidiata, intraepidermalia, astoma, patentia per fissuras, unilocularia, parietibus pseudoparenchy-

matis. Conidiophori bulbosi, breves, surgentes e stromate basali; conidia hyalina, dorsiventralia, paulisper curvata, 4-cellulata, cylindrica in medio, fastigata ad utrumque apicem, $8.5-18.7 = 1.7-2.6 \mu$; cellula apicalis desinit in caudam longam, curvatam, hyalinam, filiformem, atque supportat in latere concavo prope basin appendicem longam, hyalinam, lateralem magnit. $17-28 \mu$; cellula basalis fastigatus in appendicem hyalinam, tenuem, vulgo curvatam, $3-9 \mu$ longam.

In foliis emortuis *Eucalyptus globuli* L. ad Poona in India a T. S. Viswanathan, mense julio anni 1958.

While originally Sydow and Mitter (1935) described the spores of the type fungus as one-celled and the basal appendages as stalks, Subramanian and Ramakrishnan (1956) have recently published an emended account of the type describing the spores as 4-celled and the "stalks" of Sydow and Mitter as the basal appendages. Chona and Munjal (1955) describe the spore as 2-celled and the apical and basal portions as part of appendages. A critical study made by the writer both of this species as well as the type on *Mangifera indica* L. showed that the apical and basal portions took the aqueous cotton-blue stain readily leaving the filamentous portion unstained, thus proving the validity of Subramanian's and Ramakrishnan's description of the spores as 4-celled.

Besides being a new species, the fungus constitutes a new record for the Bombay fungi.

The type specimens have been deposited in Herbarium Cryptogamæ Indiæ Orientalia, New Delhi, India and the Herbarium of the Commonwealth Mycological Institute, Kew, England.

The author is very grateful to Prof. M. N. Kamat for guidance, to Prof. S. P. Agharkar, Director, for facilities offered at this laboratory and to Rev. Father H. Santapau for the Latin rendering.

M.A.C.S. Laboratory, T. S. VISWANATHAN.
Law College Buildings,
Poona-4,
October 31, 1958.

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REVIEWS

Progress in Crystal Physics, Vol. I. *Thermal, Elastic and Optical Properties*. By R. S. Krishnan. (Published by S. Viswanathan, "Acton Lodge", Madras-31), 1958. Pp. vi + 198. Price Rs. 20.

The aim of this series, according to the author, is to make available critical reviews of the "available data on the physical properties of non-metallic crystals in a form most useful to the workers in Crystal Physics". The Department of Physics of the Indian Institute of Science, Bangalore, has been interested in these problems for the past several years and has itself contributed a good amount of data and theoretical work. The author, who is the present Head of this Department, is therefore particularly well fitted to undertake this work of reviewing the publications in the field.

The first volume, under review, consists of seven chapters respectively on Thermal Expansion, Thermal Conductivity, Elastic Constants, Photoelastic Effect, Thermo-optic Behaviour, Faraday Effect and Dielectric Properties, each one prepared by one or more of the workers in the Department together with Prof. R. S. Krishnan. There is a short introduction of 8 pages (probably far too short), dealing with elements of crystallography, method of growing crystals, number of various constants in the different crystal classes, etc.

Each chapter contains a short review of the main developments in the subject, followed by an exhaustive summary of the available data. In the review part, an attempt is made to mention not only the various experimental techniques available but also the theoretical implications of the results obtained. Obviously it is not possible to do justice to all this in a space of 20 pages or less. As a consequence, it is not possible for a reader unacquainted with the field to get familiar with it from reading this book. On the other hand, practically every paper of significance is mentioned and so the book forms an excellent source of reference to the workers in the field. In the collection of data also, no effort has been spared to make it complete and so the tables at the end of each chapter provide an exhaustive list of the available data. The authors and the editor have to be complimented on the very thorough manner in which they have done this.

A few minor criticisms may be made. There are a few errors in the Tables, e.g., ψ for potassium chlorate is available in the original paper, but not given in Table IV (p. 38); so also the probable errors are omitted for boric acid, although reported in the original paper (p. 41). It would have been better if the angle ψ were defined uniformly in the article, say, as that between OX_1 and a , measured positive towards c , and all the data given according to this convention in the Tables.

A more serious criticism is the complete omission of all references to Raman's theory of elasticity, except a vague statement that it assumes "stresses and strains of a character different from those in the classical theory of Cauchy". The "molecular" theory of wave propagation in crystals as developed by Raman and Viswanathan, and independently by Laval, and tested at least in one case by Le Corre, is not even mentioned in the body of the review. The chapters on the optical and magneto-optic properties are particularly well written.

All these do not detract from the value of the book, which provides for the first time a comprehensive and readily available source book of the literature on the subject. It is warmly recommended to all libraries interested in crystal physics.

G. N. RAMACHANDRAN.

Biophysical Chemistry. By John T. Edsall and Jeffries Wyman. Vol. I. (Academic Press, Inc.), 1958. Pp. 699. Price \$14.00.

Biological systems defined in terms of chemical molecules are by and large dominated by proteins and we seem to have gained some understanding of the connection between certain life processes and the associated chemical changes. The subtler connections, however, seem to be at the present moment beyond our comprehension. In recent years biology has contacted physics and even mathematics, and today we find a new borderline subject rapidly developing under the title Biophysics.

The present volume has much to say regarding the physico-chemical aspects of chemical components making up a biological system, of which we find a variety, namely, acids and bases, polar molecules, electrolytes, etc. Chemical reactions supply the biological system, as

long as it is endowed with life, with vital energy necessary for its function. Rightly, therefore, in this volume, a good number of pages are devoted to thermodynamics and its application to chemical reactions. Starting from fundamental principle and definitions, the authors take the reader to the applied aspect, namely, chemical thermodynamics.

The subject is presented under eleven headings:

Biochemistry and Geochemistry; Water and its biological significance; Problems of protein structure; Thermodynamics; Electrostatics: Its application to polar molecules and ionic solutions; Dielectric constants and their significance; Conductivity of electrolytes; Acid-base equilibria; Polybasic acids, bases and ampholytes, including proteins; Carbon dioxide and carbonic acid; Some general aspects of molecular interactions. A list of references cited at the end of the chapters will be found to be of much value for those who are interested to go deeper into the subject. The volume which is claimed by the authors to have been born out of a course of lectures on physical chemistry of biochemical systems has been written mainly with the biochemists in mind. But the average biochemist may experience difficulty in following some of the chapters for they are inevitably bound up with a mathematical treatment. The book will serve as an introductory guide for the enterprising physical chemists who want to put their knowledge to use, in a fascinating field, whose mysteries are yet to be unfolded. The arrival of subsequent volumes on the subject will be awaited with much eagerness.

A. J.

Peace or Atomic War. By Albert Schweitzer.
(Asia Publishing House, Bombay-1), 1958.
Pp. 45. Price Rs. 3.00.

This booklet embodies three broadcast Appeals from Oslo, made in April 1958, by one of the most challenging personalities in the world today. Dr. Schweitzer, who has the unique distinction of having won Doctorates in four subjects, *viz.*, Philosophy, Theology, Music and Medicine, and who gave up the glittering prizes of life to become a medical Missionary in the jungles of Africa, has raised his powerful voice against nuclear tests and Atomic warfare. "Generation after generation, for centuries to come, will witness the birth of an ever-increasing number of children with mental and physical defects." Discussing the perils of an Atomic war, he quotes an American General as saying, "If at

intervals of ten minutes, 100 H-bombs are dropped over the U.S.A., there would be a casualty list of 70 million people. Countries like England, West Germany and France could be finished off with 15 or 20 bombs". 9235 leading Scientists of all Nations have declared emphatically against the continuance of nuclear tests; but the Atomic Powers lend their ears only to the reassuring and propaganda statements of their own scientific stooges. Quite recently, there have been reports of successful U.S. nuclear tests in outer space, and these will weave new deadly radiation belts round the Earth. The rate of radioactive Strontium fall-out from the stratosphere is stated to be very much faster. "The ethic of reverence for life is the ethic of love widened into Universality," says this great Man of Peace; "a single H-bomb can destroy a million human beings," gloats the Cold Warrior. Man's survival in this planet depends upon which of the two attitudes to life will survive.

S. R. K.

Biochemical Society Symposia No. 15—Metals and Enzyme Activity. Edited by E. M. Crook. (Cambridge University Press, London N.W. 1), 1958. Pp. 102. Price 21 sh.

The symposium under review is a collection of the papers read and the discussions held in the Conference of Chemists and Biochemists at the University of Leeds in 1956 and has been edited for publication by E. M. Crook. An increasing number of enzymes have recently been found to require for their activity, trace elements such as zinc, molybdenum and the like, and every one will welcome the book for its comprehensive survey of our present knowledge in this field.

In the first paper, R. S. Nyholm has discussed the nature of the bond between metal atoms and the organic groups to which they are attached. The function of metal ions in enzyme systems has been discussed by L. E. Orgel and has been brought up-to-date in the light of recent findings. It is one of the best review articles so far written on the subject and is noteworthy for its critical analysis of the various possible types of interaction between metal ions on the one hand and substrate or enzyme molecules on the other. B. R. Rabin has an article on the significance of the metal peptide complexes in relation to proteolytic activity, and has discussed in it the earlier hypothesis on the subject put forward by E. L. Smith and I. M. Klotz.

Non-specific activation by metal ions has been dealt with by F. C. Happold and R. B. Beechey, with particular mention of the effect of sodium, potassium and ammonium ions on tryptophanase activity. Also in a very lucid account of the function of heavy metals, F. Bergel and R. C. Bray have referred to the role of such metals in oxidations catalyzed by Xanthine oxidase and other metallo-flavo proteins. In the concluding article, E. C. Slater has presented a well documented survey on haemoproteins with special reference to cytochromes.

The book is well got up and is a very valuable publication dealing with the biological significance of metal ions. Its contents will appeal to a wide range of research workers, including inorganic and organic chemists, biochemists and specialists in the medical sciences.

P. S. SARMA.

Advances in Enzymology, Vol. XX. Edited by F. F. Nord. (Interscience Publishers, Inc., New York), 1958. Pp. vii + 488. Price \$12.50.

The current volume of *Advances in Enzymology* is noteworthy for the breadth of its coverage and in keeping with its international character has contributors drawn from various parts of the world including the U.S.S.R. The topics reviewed in this volume include optical activity with reference to enzymic synthesis of optically active compounds occurring in nature, Kinetics of alcohol dehydrogenase—DPN interaction, Imidazoles in biological systems, Uridine diphosphogalactose, Substrate and mode of action of Neuraminidase, Components of the respiratory chain in animal tissues, Enzymology of the plastids, Transformations of steroids in micro-organisms, Mechanism of hydrolysis of choline esterase and related enzymes, Biosynthesis of dicarboxylic acids in plants, Pectic enzymes and their substrates and Antibiotics in plant pathology. The presentation in every case is well documented and is followed by a list of pertinent references. The book has a Foreword by the Editor who cites a few well chosen examples to illustrate the set-backs suffered in the development of new ideas by the operation of the personality cult in the scientific field.

Among the highlights in this volume, the article by Barnard and Stein entitled "The Roles of Imidazole in Biological Systems" is timely and fulfils a long-felt need for an extensive coverage of the literature on the imidazole, which is fast getting recognition as a group to be reckoned with, in explaining the catalytic activity of various enzymes. The imperative necessity for

a group specific reagent for imidazole is stressed as also the various aspects of imidazole such as its chemistry, catalytic activity and chelating property. The essential nature of the imidazole group in the activity of choline esterase is also discussed at length by Davis and Green, drawing on the evidence obtained from Kinetic and inhibition studies on this and related enzyme systems.

The enzymology and biology of Uridine diphosphogalactose is reviewed by Kalckar and in this he also traces briefly the work carried out by his group on the etiology of the disease, "galactosemia".

The article by Slater entitled "The Constitution of the Respiratory Chain in Animal Tissues" is a critical appraisal of the claims of various compounds commonly considered as components of the respiratory chain. The picture of the respiratory chain as envisaged by this author is in broad agreement with the findings of the other research workers in this field except for the position of cytochrome 'b' which does not find a place in his scheme in the pathway of oxidation of DPNH in mitochondria. However, as emphasised by this author, the last word on the subject has not so far been said and the increasing tempo of research evident in this field may soon help to clear much of the uncertainties which exist at present in regard to the role of Vitamin K, α -tocopherol and related compounds as carriers in the respiratory chain.

Among other articles of interest, may be mentioned the one by Sissakian, who calls attention to the various biochemical functions the chloroplasts have, in addition to their role in Photosynthesis. The field of steroid transformations by micro-organisms is surveyed by Vischer and Wettstein mentioning in particular the ample opportunities for basic research which exist here for the enzymologist.

Though not entirely free from typographical errors, the book in its get-up and in the selection and treatment of topics comes up to the high standard, which one has come to expect of this annual collection of authoritative reviews in *Enzymology*.

P. S. SARMA.

Surgical Convalescence. By F. C. Dohan and others. (*Annals of the New York Academy of Sciences*, New York, Vol. 73, Art. 2), 1958. Pp. 381-538.

The process of recovery of a patient to the original normal working state after a surgical operation depends on physical, chemical, metabolic, psychological, social and economic factors.

This monograph has explored the factors influencing the total duration of the convalescent period after surgery and is quite an unique contribution to our knowledge of surgical convalescence.

The fifteen scientific papers forming the monograph represent extensive clinical studies and biochemical investigations undertaken to understand the various aspects of body response to injury. The observations and conclusions have resulted out of the scientific study conducted on Americans under conditions existing in United States. Whether the same observations would hold good for our patients here in India is to be investigated and studied.

The paper on physiological response of domestic animals during the immediate post-surgical period presents interesting features such as rapid convalescence and demonstration of spontaneous activity immediately after recovery from anaesthesia. This is in contrast to the response we observe among human subjects.

The need for a rehabilitation programme, particularly for those who have prolonged convalescence, has been rightly stressed. This will not only help the patients to get back to their working state earlier but also will minimize the boredom.

In content these papers reflect the surge of interest in research in the field of Surgical Convalescence.

H. K. SRINIVASA MURTHY.

The Basic and Clinical Research of the New Antibiotic, Kanamycin. (*Annals of the New York Academy of Sciences*, Vol. 76, Art. 2), 1958. Pp. 17-408.

Search for new antibiotics, less toxic, and capable of acting on the organisms which have become either resistant or are not inhibited by the antibiotics now in use, is going on at a fast pace all over the world. The claims of many of these have, within a short period of their introducing, found to be premature and exaggerated. In this atmosphere of scepticism, it is heartening to come across this volume, which presents a simple record of the investigations carried out on a new antibiotic, Kanamycin and leaves the reader to form his own opinion on the usefulness and efficacy of this antibiotic.

The Japanese workers, the original discoverers of this antibiotic, have reviewed their work on the isolation, development, properties and early clinical applications. The later researches, carried out mostly in the various laboratories of the U.S.A., have been very lucidly presented

by the investigators. The aspects dealt with in the early chapters are chemistry of Kanamycin, microbiological and pharmacological studies, interrelationship of cross-resistance with other antibiotics and the efficacy of the antibiotic on experimental infections.

The latter half of the volume is devoted to the clinical experiences with Kanamycin in pulmonary tuberculosis, pyoderma, *Salmonella* and *Shigella* infections, surgical infections, staphylococcal epidemic in infants and clinical evaluation in resistant bacterial infections.

The basic and clinical researches of this antibiotic, its potential usefulness and limitations in clinical medicine have been very ably summarised in the concluding chapter by Finland and constitutes a critical unbiased appraisal of the entire study on Kanamycin. M. SRSL.

Vladimír Pokorný : *Grundzüge der Zoologischen Mikropaläontologie* Band 1. (Published by Veb Deutscher Verlag der Wissenschaften, Berlin), 1958. Pp. xii + 582. Price DM 48.

Dr. Pokorný's book on Micropalaeontology published in 1954 in Czech (*Zaklady Zoologické mikropaleontologie*, pp. 652, Nakl. CSAV Praha, 1954) evinced great interest and micropalaeontologists all over the world owe a debt of gratitude to the author for placing before them the present German edition which obviously will be read and understood by a much wider circle. Micropalaeontology today has acquired much importance because of its ready application to stratigraphical problems in the oil industry. The available literature is vast and the groups that come under microfossils are ever on the increase. Marcus Hanna (*Significant Advances and Trends in Geology—Proceedings, 4th World Petroleum Congress*, Section I/D, Rome, 1955) pointed out that present-day palaeontology is not mere descriptive palaeontology but tries to understand and interpret what fossils mean with reference to the sediments in which they are found. There is no denying that all fossils, large or small, are useful. But microfossils being small tend to show a greater uniformity in character over wider areas and therefore have a special attraction to the palaeontologist engaged in economic work. The "Grundzüge" under review is a more advanced text-book than the English "Principles of Micropalaeontology" by Glaessner and covers not only the descriptive part of micropalaeontology but also the various methods of preparing the sample, the choice of which again depends on the group of microfossils one wishes to study, photography of

microfossils, methods of correlation and the stratigraphic as well as geographic distribution of the various groups of microfossils. The author has taken note of recent researches in the field of Cretaceous-Tertiary boundary and has taken the top of the Maestrichtian as the end of the Cretaceous period.

The book is divided into 10 chapters, the first three of which deal with definition and concept of Micropalaeontology; this is followed by a brief historical survey, collection and methods of preparation for the study of the various kinds of microfossils including special techniques, the use of ordinary stereomicroscope, polarizing microscope and electron microscope in the study of microfossils and methods of correlation, both local and regional. The groups of fossils described are the Protozoa (Radiolaria, Thekamœba, Foraminifera and Tintinnina), some organisms whose systematic position is not clear (Pithonella, Stomiosphæra, Cadosina and Oligostegina), Chitinozoa and Hystrichosphærids. A very welcome feature of the book is the numerous large and clear illustrations which are placed alongside the descriptions for easy reference.

Foraminifera naturally take up the greater part of the book. There are certain departures from the classification of Cushman as a result of more recent systematic studies bringing in a happy blend of the researches made in the USSR and allied countries as well as those from outside this sphere in Europe and America. There are minor taxonomic points in which fellow palaeontologists may differ from the author, for example: the inclusion of the arenaceous forms Geinitzina and Spandelina in the typically calcareous group Nodosariidæ, the inclusion of Gumbelitra under Orbulinidæ while the related forms Gumbelina and Pseudotextularia are found under Heterohelicidæ. The treatment of Lenticulina under various subgenera is a point about which there are likely to be differences of opinion. In some cases the ranges of genera given do not conform to their known ranges. Some of the important examples are Siderolites (U. Cretaceous—Recent), Miscellaneous (U. Cretaceous—Recent), Aktinocyclus (M—U. Eocene), Halkyardia (M. Eocene—Aquitanian). As far as the reviewer is aware Siderolites is restricted to the Maestrichtian. Miscellaneous is typically Paleocene, Aktinocyclus is also known from Paleocene and Halkyardia is not known outside the Eocene. The author has included Calcarina as a synonym of Siderolites. This will probably be unacceptable to many palaeontologists. Also certain genera like Somalina, Saudia and Fabiania have not been

mentioned. These are but minor points and should not distract from the value of the book especially since the book is not exclusively dealing with Foraminifera.

Exhaustive references covering the subjects dealt with in the book, classified under different heads for easy reference, a general index, a taxonomical index and an author index are given at the end.

This is probably the best book on the subject and should prove to be an excellent reference book to both systematic and economic micropalaeontologists. The book is well printed and the price is reasonable. It is hoped that the second volume covering Metazoa will be published early. There is no text-book on Ostracoda and this is one of the most useful groups for the economic palaeontologist. This has been fairly well covered in the earlier Czech edition and it is hoped that the author will cover this group fairly well in his second volume.

Y. N.

Flowering Plants of Eastern India, Vol. 1. (Monocotyledons.) By J. N. Mitra. (The World Press Private Ltd., Calcutta), 1958. Pp. xx + 388. Price Rs. 30.00.

The *Flora of Assam* by Kanjilal *et al.* (1935-40) is the last important work on the Flora of a part of Eastern India, but leaves a series lacuna in knowledge owing to the non-inclusion of Monocotyledons of Assam except Gramineæ. Mitra's present volume dealing with the Monocotyledons of Eastern India is, therefore, a welcome addition to the knowledge of Botany of the region in general and those of Assam in particular.

The other merits of Mitra's volume are the presentation of the 35 monocot families of Eastern India in a classification of his own and the enunciation of a comprehensive 'key' for easy identification of the families, genera and species, which include a certain exotic monocot species introduced and cultivated in gardens together with their Bengali/vernacular names.

All the same the volume suffers greatly from an over-ambitious scheme which has been too hastily pursued and rapidly rushed through for publication.

The author's classification of the monocot families is claimed to be phylogenetic but it should have been accompanied with a critical analysis and the floristic divisions (p. xvi), followed by a discussion to be thought-provoking and acceptable.

Again, the entire monocot flora of author's 'Orissa' with the exception of Glumifloræ and

Orchidaceæ, has been represented by 6 species alone (*vide*, pp. 2, 21, 48, 51, 53, 64 in addition to the references to species occurring in whole of Eastern India). Similarly *Paleosanthes bakeri* Hkf., *Smilax quadrata* ADC, *Dioscorea prazeri* Prain & Burkill and *Oxytenanthera parvifolia* Brandis (*ex* Gamble from Assam) are a few of the large number of species collected and deposited in Shillong Forest Herbarium but not included in the present volume. The occurrence in Assam of a very large number of monocot species such as, *Ottelia alismoides* Pers., *Hydrilla verticillata* (Roxb.) Royle and many others described in the volume has not been noted at all. These avoidable omissions are presumably due to the author's not consulting the monocot species available in the former Shillong Forest Herbarium (now Shillong Regional Herbarium of Botanical Survey of India).

While the author has adopted the changes in nomenclature in many instances (*viz.*—*Mondo*, p. 42, *Habenaria*, pp. 274-76, *Malaxis*, p. 294, *Murdannia*, p. 16), he has been almost oblivious of the many such changes in other genera and species. To quote a few, *Cyperus brevifolius* (Rottb.), Hassk (for *Kyllinga brevifolia* Rottb.), *C. globosus* Allion (for *Pycneus globosus* Reichb f.), *Ananas camosus* (Linn.) Merr (for *A. sativus* Schult f.) [cf. Santapau, "Flora of Khandala, etc." in *Records of Botanical Survey of India*, XVI, (1), 337-Seq., 1953]. Similarly, records of new species from Eastern India, such as, *Poa eleanora* Bor, *P. poophagorum* Bor in *Kew Bull.*, 1948, 142-143 (1948) and many others have not been included in the present volume, published in 1958.

A number of mistakes in spelling of technical terms, such as occur on pages 53, 143, 152, 155, 278, 312 and 349 could have been corrected in proof. The description of *Galeola falconeri* Hook f. (p. 284) is incorrect.

Despite these mistakes and omissions, however, the get-up and printing are good and the present volume is a definite contribution to the knowledge of Botany of the region.

G. PANIGRAHI.

Bird Hybrids : A Check-List with Bibliography.

By Annie P. Gray. (Commonwealth Agricultural Bureaux, Bucks, England), 1958. Pp. viii + 390. (24.5 × 15.5 cm.). Price 50 sh. net.

A fundamental point in the modern concept of the species is that it should be reproductively isolated. Reproductive isolation between species

is achieved in several ways : geographical or ecological separation, structural differences, physiological incompatibility where distributional ranges overlap, and others. Even though crossing between some strikingly different species is artificially possible, and occasionally occurs also in nature, the hybrids are normally either physiologically defective, or sterile, *i.e.*, they are incapable of breeding *inter se* and thus perpetuating their intermediate characteristics.

The superficial morphology of hybrids is often quite confusing. The confusion is increased by the fact that in many birds the young differ so markedly from their parents in appearance and in others the sexual dimorphism is so great, that in the past young and old, or male and female have sometimes been ascribed to different species, or to the result of hybridization. On the other hand natural hybrids have often been attributed to new species. Descriptions of known hybrids were widely scattered in the literature of many countries and languages and references were difficult to find. Thus, to the serious aviculturist no less than to the taxonomer, the systematist and the scientific field ornithologist the present compilation in a single volume of all the published as well as unpublished, reports of bird hybrids should prove invaluable. It gives a concise history of most of the crosses recorded and furnishes useful suggestive data which have an indirect bearing also on genetics, courtship patterns and isolating mechanisms. The hybrids are grouped within families and are arranged alphabetically under the scientific names of the species involved. Under each species is given a full list of those with which it is said to have hybridized, or with which hybridization has been attempted. Thus, under *Anas platyrhynchos* (the Wild Duck or Mallard)—the progenitor of our domestic duck—hybridization with no less than 50 species is recorded, some belonging to widely distinct genera, *e.g.*, *Anser*, *Branta*, *Mergus*. The strangest report of all is of the hybridization in this duck with a Guineafowl ; the authenticity of this seemingly impossible cross is, however, mentioned as 'extremely doubtful'. Natural hybrids among the Anseridæ, particularly the ducks, are well known, and a number of such have been shot in India by sportsmen from amongst the migratory species. Other groups of birds in which hybridization is common are the Pheasants (Phasianidæ), Parrots (Psittacidæ), Humming Birds (Trochilidæ), Birds of Paradise (Paradisæidæ) and Finches (Fringillidæ). This may doubtless be due, in part, to the fact that these groups con-

stitute popular aviary birds which readily acclimatize themselves to captive or semi-feral conditions. Many species living in widely separated habitats are artificially brought together in avicultural collections and thus given opportunities of mating which are denied in the wild state. Nevertheless that hybridization also does occur on a large scale under natural conditions between sympatric species is shown by the fact that many Humming Birds and Birds of Paradise, formerly recognized as distinct species have been shown, on closer study, to be nothing but natural hybrids.

The comprehensive nature of *Bird Hybrids* and the magnitude of the task of compiling it may be gauged from the voluminous bibliography which covers 78 pages and includes over 1,900 titles. An index of scientific and vernacular names facilitates ready reference.

S. A.

Books Received

Recent Progress in Hormone Research, Vol. XIV. Edited by Gregory Pincus. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1958. Pp. v + 582. Price \$13.50.

Handbook of Tropical Crop Disease. By M. N. Kamat. (Prakash Publishing House, 360, Budhwar Peth, Poona-2). Pp. 84. Price Rs. 2.50.

Modern Developments in Plant Physiology. Edited by P. Maheshwari. (Published by Botany Department, University of Delhi, Delhi-8), 1958. Pp. xi + 170. Price not given.

Electroanalytical Chemistry, II Edition. By J. J. Lingane. (Interscience Publishers, New York), 1958. Pp. xiv + 669. Price \$14.50.

Mechanical Cultivation in India. By D. A. Gadkary. (The Publications Division, Civil Lines, Delhi). Pp. vii + 147. Price Rs. 7.25.

Dairy Microbiology. By E. M. Foster, F. E. Nelson, M. L. Speck, R. N. Doetsch and J. C. Olson, Jr. (MacMillan & Co., St. Martin's Street, London, W.C. 2). 1958. Pp. xvi + 492. Price 42 sh.

Principles of Electronics, II Edition. By H. Buckingham and E. M. Price. (Clever-Hume Press Ltd., 31, Wright's Lane, Kensington, London W. 8), 1958. Pp. 419. Price 17 sh. 6 d.

Practical Invertebrate Anatomy, II Edition. By W. S. Bullough. (MacMillan & Co., St. Martin's Street, London W.C. 2), 1958. Pp. xiv + 483. Price 30 sh.

Robert Boyle and Seventeenth-Century Chemistry. By Marie Boas. (Cambridge University Press, London N.W. 1), 1958. Pp. vii + 239. Price 30 sh.

Reflex Klystrons. By J. J. Hamilton. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xi + 260. Price 45 sh.

Third Tissuehomotransplantation Conference. By J. M. Converse, B. O. Rogers and others. (*Annals of the New York Academy of Sciences*, New York, Vol. 73, Art. 3), 1958. Pp. 538-868.

Enzymes in Blood. By L. P. White. (*Annals of the New York Academy of Sciences*, New York, Vol. 75, Art. 1.) Pp. 1-384.

Perspectives in Marine Biology. Edited by A. A. Buzzati-Traverso. (University of California Press, Berkeley; Cambridge University Press, London N.W. 1), 1958. Pp. xvi + 621. Price 75 sh.

Transport Processes in Statistical Mechanics. Edited by I. Prigogine. (Interscience Publishers, New York), 1958. Pp. x + 436. Price \$10.00.

Advances in Chemical Physics, Vol. I. Edited by I. Prigogine. (Interscience Publishers, New York), 1958. Pp. xi + 414. Price \$11.50.

Organic Syntheses with Isotopes, Part II. By A. Murray and D. Lloyd Williams. (Interscience Publishers, New York), 1958. Pp. ix + 2096. Price \$25.00.

Theories of Figures of Celestial Bodies. By W. S. Jardetzky. (Interscience Publishers, New York), 1958. Pp. xi + 186. Price \$6.50.

Rational Simplifications for the Buckling Length of Columns. By T. C. Kavanagh. (*Annals of the New York Academy of Sciences*, New York, Vol. 72, Art. 2), 1958. Pp. 353-386. Price \$2.50.

The Theory and Design of Magnetic Amplifiers. By E. H. Frost-Smith. (Chapman & Hall, London, W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xix + 487. Price 75 sh.

Essential Oils and Aromatic Chemicals—A Symposium. (The Publications Division, C.S.I.R., New Delhi), 1958. Pp. xx + 174. Price Rs. 10.00.

Andhra University Memoirs in Oceanography, Vols. I & II. (The Registrar, Andhra University, Waltair), 1958. Pp. 161 and 237. Price Rs. 15 each.

SCIENCE NOTES AND NEWS

Award of Research Degrees

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri M. V. Kaulgud and Smt. M. V. Natekar for their theses entitled 'Ultrasonic Velocity in Liquids and Liquid Mixtures' and 'Alcoholysis of Oils and Fats' respectively and the Ph.D. (Agri.) Degree to Shri M. C. Srinivasan and Shri S. K. Dorge for their theses entitled 'Studies on Some Phytopathogenic Bacteria of Bombay' and 'Land Crab Control with Insecticides' respectively.

Andhra University has awarded the D.Sc. Degree in Zoology to Shri C. C. Narasimhamurti for his thesis entitled 'Studies on Protozoan Parasites from Myriapoda and Insecta'.

"ENDEAVOUR" Prizes

The Imperial Chemical Industries Limited (Publishers of the Quarterly Scientific Review, *Endeavour*, have offered prizes totalling 105 guineas for essays submitted on scientific subjects. The competition is restricted to those whose twenty-fifth birthday falls on or after 1st June 1959. The first and second prizes are of value 50 and 25 guineas respectively. Two special prizes of 5 guineas each will be awarded for competitors who have not passed their eighteenth birthday on 1st June 1959. The subjects for the essays are as follows: (1) New Sources of Power, (2) Transport in the Modern World, (3) The Exploration of Space, (4) The Mechanism of Inheritance, (5) Enzymes, (6) Man-made Fibres.

An additional prize of 20 guineas will be awarded for an essay on any scientific subject of a candidate's own choice.

In addition to the cash prizes, the prize winners will receive invitation to attend the British Association Meeting at York, from 2-9 September 1959.

Essays should be in English and typewritten, and should not exceed 4,000 words in length. Only one entry is permitted from each competitor. The essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay. All entries should be addressed to the Deputy Secretary, British Association for the Advancement of Science, 18. Adam Street, Adelphi,

London W.C. 2. The envelope should be clearly marked "Endeavour Prize Essay". The latest date for receipt of entries is 1st June 1959.

Helium as Rocket Fuel

Helium is normally thought of as an inert and chemically useless gas. But in a special state, it is theoretically the best possible store of chemical energy for rockets. The required state of helium is that known technically as 2^3s . It is produced by subjecting cold helium to radio waves of the appropriate frequency. It is unstable at normal temperatures, but at temperatures below about -200°C . it has a precarious stability.

At 4° above absolute zero it forms a solid in the presence of hydrogen. Helium 2^3s should behave chemically like lithium (a very reactive metal) and apparently combines with the hydrogen to form helium hydride.

The effectiveness of a rocket fuel is measured in terms of specific impulse, the time for which one pound of fuel will deliver one pound of thrust before it is exhausted. Present-day fuels have specific impulses of about 300 sec.; helium 2^3s has a theoretical specific impulse nearly ten times as great, 2,900 sec. Helium hydride is not much inferior, at 2,400 sec.—*The New Scientist*.

New Method of Exploring Atomic Nucleus—Bombardment by Heavy Ions

A new way of exploring the atomic nucleus has been suggested by Prof. Vitaly Goldansky of the USSR Academy of Sciences.

It is known that atomic nuclei have 'shells' consisting of nucleons which can shift from one shell to another, thereby altering the internal structure of the nucleus. It may be presumed that other and still more delicate phenomena can occur in the nucleus—the shifting of nucleons inside the shells proper, producing the hitherto unknown energy levels. The detection and identification of the phenomenon will provide a great deal of interesting data on the structure of the atomic nucleus.

Prof. Goldansky believes, however, that this cannot be effectively studied by ordinary means, i.e., by bombarding the nuclei with elementary particles or the simplest nuclei. When hitting the target nucleus, these particles bring in an excess

dose of energy, which in most cases destroys the nucleus instead of changing its structure. He suggests that in order to make protons and neutrons "shift" within the shells the nuclei should be bombarded with heavy ions (atoms stripped of some of their electron shells) at a low energy at which they are hardly likely to fuse with the target nucleus. Such interaction can lead to a neutron "exchange" and to an alteration in the nucleon interaction inside the nuclear shells. Prof. Goldansky believes, the changes involved can easily be observed by the gamma rays emitted by excited nuclei. This method of nuclear investigation will be one of the most delicate methods of affecting the structure of the atomic nucleus.—*Science News-letter*.

Tubing as Thin as a Human Hair

Microtubing so small that it compares in diameter to a human hair, yet has many desirable properties for industrial applications, will be produced by a large American chemical company.

Tentatively named Santotube Q, the tubing which is made of quartz, will be three thousandths of an inch in diameter. It is so tiny that it would take 40 miles of the tubing to weigh one pound and a 50-foot length to hold a single drop of water. It is so flexible that it can be tied in knots, has a greater tensile strength than steel, is resistant to high temperatures, is highly inert to chemicals and is a non-conductor of electricity.

The tubing was originally developed by the company's research scientists in fibre form for the Atomic Energy Commission. It is now available to industry, and is expected to play a prominent part in a new development for recovering large quantities of helium, now lost annually in natural gas.—*SACSIR Science News Selections*.

Fluorescent Area Light

Westinghouse scientists are producing fluorescent light in large, thin, rectangular glass plates no more than an inch thick.

Representing a major change in design from the conventional fluorescent tube or line source of light, the unusual lamps consist of a labyrinth or maze of passages sealed in a thin glass block. The arc or electric discharge travels in a winding path through the glass block to produce, in effect, a large area source of light.

Typical models now in the laboratory measure 24 inches long by 8 inches wide by

1 inch thick, and 12 inches square by 1 inch thick. There are also models with a reflector on one side so that all the light can be reflected through a single side of the lamp.

Because the new fluorescent lamps require a fixture with practically no depth, they can drastically reduce the amount of ceiling space required to mount the lamps. Square-shaped lamps could be used as glass bricks or tiles in ceilings, walls and floors. Extensive future applications are foreshadowed for this new lamp. These fluorescent area light sources are not presently scheduled for production.

Holes of Negative Mass in Germanium

In semiconducting materials such as germanium currents are carried not only by electrons (negative charge) but also by "holes" (positive charge) which can be thought of as electron deficits in the crystal that can be transferred from one point to another, but in fact seem to have more reality than this picture may suggest.

Workers at the RCA Laboratories, Princeton, have studied the absorption of ultra-high-frequency radio-waves in germanium subjected to a magnetic field at very low temperatures and have found new evidence for the existence of holes of negative mass. There is a reduction in the absorption at certain values of the magnetic field where the holes of presumed negative mass resonate with radio-waves, meaning that the current-carriers lose energy—rather than gain it, which is usual in an absorption process.—*New Scientist*.

Silicon Solar Cells

These cells are a device to convert sun's rays directly into electrical power.

The U.S. Vanguard satellite, still circling the Earth, has been equipped with 108 cells located in six clusters placed symmetrically around the sphere's surface to convert sunlight of outer space into electrical power which operates one of the satellite's radio transmitters.

Solar converters are wafer-thin discs of extremely pure silicon fused with minute amounts of arsenic and boron, which create the electron groupings that provide positive and negative electrical fields. After etching, plating and testing the cells are joined in series of various sizes and shapes to meet requirements of specific applications. Light photons penetrating the silicon cause the flow of electrons and result in a voltage build-up within each silicon cell. This converted energy is then conducted to whatever outlet has been provided.

The world's first commercial solar cell panel, a 144-cell modular assembly made by Hoffman, Electronic Corporation, is designed to supply electrical power in multiples of five watts. Remote areas without electrical power sources may rely on a system of these modular units for constant power.

Silicon solar cells have an estimated life-time of many years, do not deteriorate and are virtually unaffected by humidity and temperature variations. They also convert incandescent light into electricity.

Silicon solar converters made to-day have a top efficiency of about 10%. While not far enough developed at the present time to compete economically with high voltage electrical power, the converters are considered ideal for supplying low-power requirements in lieu of heavy, generated electricity.—*J. Frank. Inst.*, October 1958.

Thin Films of Glass for Electrical Devices

Extremely thin films of glass which can be used to make synthetic mica for electrical insulators and "rugged" electrical condensers have been produced by some Russian workers. The films are made by forcing molten glass through a narrow slit in the bottom of a melting vessel. The falling ribbon of glass that emerges is stretched and thinned by pulling it on to a rotating drum, the thickness of the film being controlled by adjusting the speed of rotation. Widths up to 4 inches and constant thickness in the range 0.0002-0.002 inches can apparently be obtained. Such thin film of glass are perfectly pliable and, since the melt is continuously replenished, long strands can be wound on to the drum. Various glasses can be treated in this way: among the compositions studied are lead and borosilicate glasses.

It is reported that synthetic mica was prepared by stacking short pieces of film to the required thickness. After moistening, the stack can be moulded under light pressure to form any desired shape which, after drying, will be permanently retained as the films are held together by the attraction between the molecules. The electrical properties of this artificial mica are similar to those of the natural kind. Experiments along similar lines were reported by an American worker in 1946. The Russians, however, seem to have taken their process to a stage where it can be exploited industrially.

The condensers consist of laminations of thin copper foil alternating with glass film, which

are heated to the softening point of the glass when the film fuses to the copper to yield a solid block. The condensers have a high capacitance per unit volume and are naturally stable under extremes of temperatures and humidity. It is claimed, moreover, that the process lends itself to mechanisation much better than the method of making orthodox mica condensers.—*New Scientist*.

Cryopumping for Production of High Vacuum

Cryopumping is a new technique for the production of high vacuum. In principle the method consists in freezing all of the air in an enclosed chamber to a solid, thus leaving a high vacuum in it. It is being successfully employed by the Missile Research Laboratory of the University of Southern California to simulate, in their Hypersonic Wind Tunnel, conditions obtained at very high altitudes in the atmosphere.

The cryopump is an extreme low temperature refrigerator, using helium gas at -420°F . as the refrigerant. At present it is most efficiently used in conjunction with mechanical pumps. Low pressures of the order of 10^{-4} mm. can easily be produced with the cryopump.

In the Hypersonic Wind Tunnel, instead of blowing or pulling air over the test models by conventional means, which would require pumps and fans and occupy large space, the cryopump freezes nitrogen gas out of the stream at one end, causing a flow of nitrogen from the other end of the tunnel and over the objects being tested. Nitrogen is used instead of air to eliminate the need to remove moisture from the gas stream. The temperatures of the tunnel at the cryopump end is around -450°F . In order to duplicate high temperature conditions under which missiles would operate at high speeds, the nitrogen gas is heated electrically on its entrance into the tunnel and again just before it flows over the models. After the nitrogen passes over the models, it is drawn on to the large metal plates of the refrigerator, where it condenses and freezes.

Missiles placed in the tunnel can thus be tested as though they were flying at 20 times the speed of sound and nearly 60 miles above the earth.

The USC Tunnel is unique in that its only moving parts are in the refrigerator, which runs on a 50 H.P. motor. A comparable unit based on a gaseous diffusion pump would require 500,000 H.P.—*J. Frank. Inst.*, January 1959.

Origin of Chemical Elements

The interaction of elementary particles with heavy elements is one of the main problems of contemporary physics the solution of which will help in the development of a comprehensive theory on the atomic nucleus and the origin of elements. Soviet experiments with the proton synchrotron have shown that by irradiating hafnium, the element next to the rare elements in the periodic table, with a flux of accelerated elementary particles of energy up to 660 Mev., it has been possible to obtain light isotopes of a number of rare elements. Light isotopes of rare elements have also been created by splitting uranium.

These experiments prove the possibility of formation of lighter elements out of heavy elements as a result of interaction with particles of energy much less than the energy of cosmic rays. This leads to the view that one of the most probable ways of element formation is the action of cosmic rays upon atomic nuclei. In the conditions of a plasma ball which possibly preceded the formation of earth, intensive neutron fluxes might have played the role of cosmic rays.

This process is especially intensive in meteorites. The latest studies of meteoritic matter had discovered traces of the splitting of iron, calcium and other elements.—A. Vinogradov: *USSR News*.

Origin of Solar X-Rays

Rocket observations of the solar eclipse of October 1958, undertaken by U.S. as part of the IGY programme, help to locate the region of the sun's atmosphere in which solar X-rays originate.

Five rockets were fired before, during and after the eclipse from a ship off the Danger Island in the Pacific. Four of them reached the required altitudes of 139 to 150 miles. Data telemetered back from the rockets indicated that as the surface of the sun was obscured by the moon, ultraviolet radiation diminished but the intensity of X-rays was unaffected. These observations seem to confirm the belief that whereas the ultraviolet radiation comes from the lower part of the sun's atmosphere or the chromosphere the X-rays originate in the sun's outer atmosphere or the corona.—UNESCO, No. 326, March 9, 1959.

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NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATIONS

1. INTRODUCTION

IN order to account for the hyperfine structures in atomic spectra Pauli put forward the suggestion in 1924 that the nucleus should possess an angular momentum and a magnetic moment. It is therefore to be expected that materials which are otherwise diamagnetic should exhibit a weak paramagnetism if the nuclei within them have a magnetic moment. This nuclear paramagnetism was first demonstrated for solid hydrogen by Lasarew and Schubnikov in 1937, employing conventional magnetic methods.

The atomic beam experiments of Stern and Gerlach paved the way for the study of magnetic moments by beam deflection methods, which ultimately led Rabi and his colleagues to introduce the resonance technique employing molecular beams. These elegant molecular beam experiments successfully demonstrated nuclear magnetic resonance for the first time. That the resonant exchange of energy between the levels split by the application of an external magnetic field should also be observable with matter in bulk, containing nuclei possessing a magnetic moment was realised as early as 1937 and several attempts were made by Gorter and Gorter and Broer to observe the phenomenon but without success. The first successful nuclear magnetic resonance experiments using bulk material were reported in 1946 by Purcell, Torrey and Pound and quite independently by Bloch, Hansen and Packard. In the thirteen years that have elapsed since the announcement of these experiments, the subject of nuclear magnetic resonance has had a phenomenal development, and many are its applications which cover different branches of science. To mention a few examples, the technique is used to investigate structural problems in chemistry, as an analytical tool, and to control magnetic fields to a high degree of stability. In this article the basic concepts of nuclear magnetic resonance, the experimental techniques involved and some applications will be briefly set out.

2. BASIC CONCEPTS OF NUCLEAR MAGNETIC RESONANCE

Atomic nuclei made up of odd number of nucleons possess an intrinsic angular momentum and are characterised by a spin number designated as I , which may be an integer or half

integer. The largest measurable component of this angular momentum is given by $I\hbar$ where $\hbar = \frac{h}{2\pi}$. Such nuclei have usually a magnetic moment associated with them. For our present purpose this quantity is of interest and we shall examine the behaviour of a nuclear magnet having a magnetic moment μ when placed in a steady magnetic field H_0 .

The classical treatment of such a system is due to Larmor and the magnetic dipole having a magnetic moment executes a Larmor precession about the direction of the steady field H_0 as its axis.

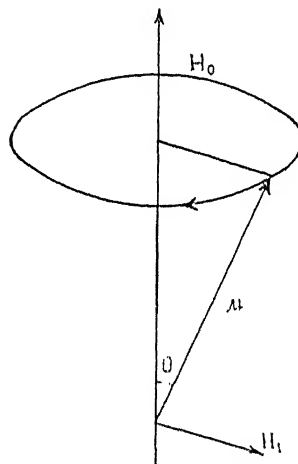


FIG. 1

Figure 1 illustrates a dipole precessing about the direction of the applied field. The rate of precession is given by the well-known Larmor angular frequency condition, $\omega_0 = \gamma H_0$ where γ is the gyromagnetic ratio of the dipole. If now a magnetic field at right angles to H_0 in the plane containing μ and H_0 is applied, the dipole will experience a couple. When the small field H_1 is made to rotate about H_0 as axis, in synchronism with the precession frequency, this couple will cause the angle θ to increase. A resonance therefore occurs when the angular frequency of the rotating field is equal to the angular frequency of Larmor precession, namely, $2\pi\nu_0 = \omega_0 = \gamma H_0$. Here it may be noticed that the small R.F. magnetic field has to have circular polarisation. However, it is not necessary to supply circularly polarised R.F. radiation. Linear polarisation is quite adequate, since it can be regarded as the superimposition of two

circularly polarised fields rotating in opposite senses. Resonance will be obtained with the component having the correct sense, the other one having a negligible effect.

This classical resonance condition agrees exactly with that derived from quantum theory. The energy levels of a nuclear magnet are split into $(2I + 1)$ values of $-m\mu H_0/I$ when placed in a steady magnetic field of strength H_0 .

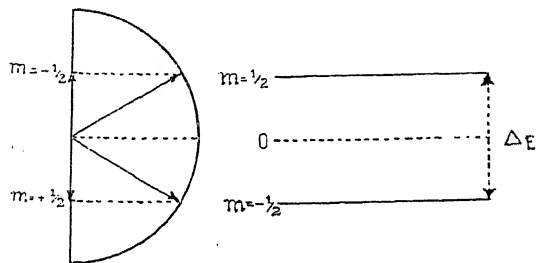


FIG. 2

In Fig. 2 these are illustrated for $I = \frac{1}{2}$. A quantum of energy

$$\Delta E = h\nu_0 = \frac{\mu}{I} H_0 = g\mu_0 H_0$$

can therefore excite transitions between the levels if it satisfies the above resonance condition. Here ν_0 is the frequency of the electromagnetic radiation and g is the splitting factor or g -factor ($g = \mu/\mu_0 I$) and μ_0 is the nuclear magneton $= \frac{e\hbar}{2\pi m_p C}$ where m_p is the mass

of the proton. In general, the selection rule for a transition is for a change of $m = \pm 1$. For the proton to which the spin number $\frac{1}{2}$ is ascribed, the change is from $+\frac{1}{2}$ to $-\frac{1}{2}$, the two states having different energies. These two states correspond to the nuclear magnet being parallel and anti-parallel to the applied field. Transition can be induced from the lower state to the higher state by applying suitable radiofrequency power. For the proton, the value of g is approximately 5.58 and in a typical field of 5,000 gauss the resonance frequency works out to 21.3 Mc./s. For other nuclei, resonance occurs in the convenient radiofrequency region for comparable fields.

Thus, nuclear magnetic resonance is an absorption process involving electromagnetic radiation in the radiofrequency region. This absorption is directly related to the ratio of the number of nuclei in the higher energy to the number in the lower energy state. If the number of nuclei in each energy state were equal, no net absorption of radiation could result, for the probability for the transition upwards

by absorption is equal to the probability of transitions downwards by stimulated emission. Actually, however, since the nuclear spins are in thermal equilibrium with the surrounding, the population of the lower level exceeds that of the upper level and is given by the Boltzmann's factor $\exp(2\mu H_0/kT)$ where k is the Boltzmann's constant and T is the temperature of the substance. On account of this small but finite excess of population, there is a net absorption of energy from the radiation field and the system is subjected to a process of radiofrequency heating. Due to spin lattice interaction, however, the heat is transferred to the lattice and the population to the lower level is restored. In the event of the system being supplied with a large dose of R.F. power saturation would result.

The important quantity in nuclear magnetic resonance is the spin lattice relaxation time T_1 which is the time constant for the attainment of thermal equilibrium between nuclei and its surrounding. One might say that T_1 describes the rate at which a hot spin system cools off exchanging energy with the surrounding, commonly designated as lattice. The values of T_1 which are encountered experimentally usually lie within the range 10^{-4} to 10^4 sec. It is found to be longer for solids than for liquids and gases. It may be remarked here that the presence of paramagnetic ions in a liquid promotes the relaxation process and may reduce T_1 to less than 10^{-4} .

The relaxation time T_2 which is connected with spin interaction is of importance and describes the life-time or phase memory time of a nuclear spin state where $T_2 \sim 10^{-4}$ sec. Each nuclear magnet finds itself not only in the steady applied magnetic field H_0 but also in a small local magnetic field H_{local} produced by neighbouring nuclear magnets. The direction of this local field differs from nucleus to nucleus and varies over a range of $H_{\text{local}} = 5$ gauss. As a consequence, there will be a distribution of the frequencies of their Larmor precession covering a range of $\delta\omega_0 \sim 10^4 \text{ sec}^{-1}$. If two spins have precession frequencies differing by $\delta\omega_0$ and are initially in phase, they will be out of phase in a time $\sim 1/\delta\omega_0$. Since the relative phases change in a time $\sim 1/\delta\omega_0$, the correct phasing for this spin exchange process should occur after a time interval of this order and this would determine the life-time of a spin state. This produces a broadening of the energy levels and results in the broadening of the resonance line,

NUCLEAR INDUCTION

In a steady magnetic field the nuclear magnets absorb power from a suitably applied R.F. field. From a macroscopic point of view this absorption may be described by means of the imaginary part of χ of the complex nuclear magnetic susceptibility $\chi = \chi' - i\chi''$ of the assembly. We will not go into details of this treatment except to remark that the applied radiofrequency field produces an in-phase magnetisation and an out-of-phase magnetisation.

The amplitude of the in-phase and quadrature components are proportional to χ' and χ'' respectively. Suitable experimental arrangements were devised for the first time by Bloch and his group to amplify these components directly. Since the e.m.f. is obtained by electromagnetic induction from the precessing resultant magnetic moments, Bloch named the phenomenon *nuclear induction*.

3. EXPERIMENTAL METHODS

Two experimental methods have been devised to study nuclear magnetic resonance. The basic requirements for observing resonance are the following. A sample material about one cubic centimetre in volume containing the nuclei of interest is subjected to a steady magnetic field. A time larger than T_1 is given for the spin system to come into thermal equilibrium with the lattice in the steady field. A coil is wound round the sample contained in a tube, before it is placed in the steady magnetic field such that its oscillatory field is at right angles to the steady field. Provision must be made to vary the field H_0 to obtain the resonance condition, if the frequency is kept constant. Although the frequency could be varied, the former arrangement, namely, varying the magnetic field is much more convenient and is widely adopted for detailed work. The resonance effects are detected by their reaction on the circuit supplying the radiofrequency field. At resonance, the radiofrequency power absorbed causes a decrease in the Q factor of the circuit which produces a drop in R.F. voltage across it.

This R.F. voltage is amplified, rectified and suitably displayed. For displaying resonance, the steady magnetic field is modulated at low audiofrequency of about 25 c.p.s., and the same low frequency voltage drives the horizontal sweep of the oscilloscope. With a highly homogeneous magnetic field and observation under steady state conditions, the oscillogram gives a faithful reproduction of the variation of χ'' with the magnetic field at the fixed frequency. A

simple arrangement due to Rollin is shown schematically in Fig. 3.

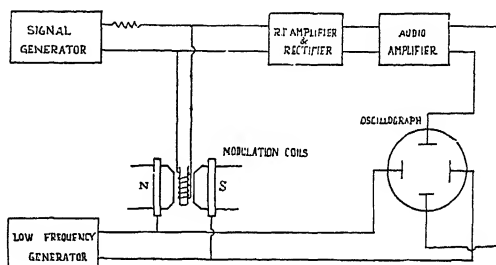


FIG. 3

In order to get a higher sensitivity, bridge circuits have been employed which allow more radiofrequency amplification before detection and also enhance the depth of modulation. In the bridge method the dummy circuit is adjusted such that the net voltage produced by it and the circuit containing the experimental material is made to approach null condition. The experimental material is placed in the coil of the test circuit and the latter is located in a homogeneous steady magnetic field. When resonance occurs the bridge is thrown out of balance and a small complex R.F. voltage equal to $V_0 [1 - 4\pi\zeta Q (\chi'' + 2\chi')]$ is produced. Here ζ is the filling factor and Q is the quality factor. Usually, the bridge is not balanced to null and the small resultant voltage V_1 combines with the complex voltage and the vector sum of the two voltages is given by $|V_{\text{sum}}| = |V_0 - V_1 + 4\pi\zeta Q |V_0| (-\chi'' \cos \phi + \chi' \sin \phi)|$. As the modulated field sweeps through the region of resonance, a curve is traced out of the form $(-\chi'' \cos \phi + \chi' \sin \phi)$. When the phase balance of the circuit is adjusted to $\phi = 0$ or π the plot obtained is the absorption curve and when it is $\phi = \frac{1}{2}\pi$ or $\frac{3}{2}\pi$ the dispersion curve is obtained. In the former case, the unbalance of amplitude results in an amplitude modulation of the R.F. voltage, while an unbalance in phase in the latter case produces phase modulation of the R.F. voltage if V_0 and V_1 are of equal amplitudes.

In order to obtain higher signal to noise ratio, the so-called phase detector or the phase sensitive amplifier is incorporated in the detector system.

While the bridge method has a wide applicability, it is not convenient for use when searching for unknown lines. The marginal oscillator method is especially suitable for such purposes. In this, the regeneration of an oscillator is adjusted to such a level that the circuit can just

sustain oscillations. The specimen is kept in the coil of the oscillator and when resonance takes place the R.F. absorption produced is equivalent to an increase in the positive shunt resistance and the oscillation amplitude falls. Thus the R.F. voltage is amplitude modulated at the rate of frequency at which the steady magnetic field is swept. This can be rectified and the audio output obtained can be amplified and displayed. A number of circuits of this type have been devised. Based on this, proton magnetic resonance field meters have been developed for accurate measurement of magnetic fields.

We now pass on to the second kind of experimental set-up devised by Bloch and his collaborators to study magnetic resonance. In this method, two coils are employed, one as the transmitter coil and the other as the receiver coil. In the actual experimental arrangement the receiver coil is wound close to the specimen and the transmitting coil is wound outside on suitable formers. This arrangement is placed in the steady magnetic field such that the two coil axes and the field lines are mutually perpendicular. The receiving coil is tuned by a parallel condenser and forms the input circuit of the first stage of a radiofrequency amplifier. This two-coil arrangement constitutes the principal part of the so-called R.F. head, and leads are brought out for connections. The R.F. head is well shielded to reduce any direct pick up by it, of the magnetic field modulation voltage. At resonance an e.m.f. is induced in the receiver coil by the precessing nuclei.

A very desirable requirement here is that the two coils should be perfectly orthogonal, in order to reduce direct pick up of the primary flux by the receiver coil. It is however not possible in practice to achieve this geometric condition and the presence of a small leakage signal as it is called can indeed be put to good use.

As stated earlier, the precessing nuclear magnetic moment has a dispersion part proportional to χ' and an absorption part proportional to χ'' . The dispersion signal and the leakage signal are in quadrature and produces a phase modulation, while the absorption signal and the latter are in phase and produce amplitude modulation. The leakage flux can be controlled by mounting a semicircular sheet of metal called a 'paddle' at the end of the transmitter coil and rotating it. This, in combination with a resistance-capacity network, with a variable condenser feeding R.F. voltage from the transmitter coil to the

receiver, enables one to obtain a leakage signal either in phase or in quadrature. A rectified signal could be obtained representing only the absorption proportional to χ'' , when the quadrature component is completely compensated by adjustment of the condenser, leaving the in-phase component incompletely compensated by adjustment of the paddle. If, on the other hand, the in-phase component is completely compensated and the quadrature component is incompletely compensated, the dispersion signal proportional to χ' can be obtained.

One important piece of information which the nuclear induction method yields is the sign of the gyromagnetic ratio which cannot be obtained by the other methods. Apart from this there is nothing much to choose between single and double coil methods.

Pulse methods have been used for the study of transient effects. The study of transient behaviour enables experimental values of the two relaxation times T_1 and T_2 to be derived.

4. APPLICATION OF NUCLEAR MAGNETIC RESONANCE

Among the applications of nuclear magnetic resonance the chemical application occupies a unique place and the NMR technique has already become a cherished tool of the chemists. These applications are possible because, the detailed characteristics of the magnetic resonance are very sensitive to various features of the nuclear environment. When a molecule possesses several resonant nuclei of the same species, but in different electronic environments, each nucleus gives a different resonance frequency. This phenomenon is known as 'chemical shift' and arises due to the fact that the nuclei in the different environments find themselves in a magnetic field, different from that of the applied field, due to the difference in the shielding effect produced by the molecular electrons. By measurement of the chemical shifts with substances either in the liquid form or in solution, a direct measure of the intramolecular shielding could be obtained. The so-called 'chemical shifts' can be used as an analytical device, in much the same way as infra-red spectroscopy. Chemical shifts can also be used to study chemical equilibria in solution.

These applications take us to what is known as High Resolution NMR Spectroscopy where the stability and homogeneity of the static magnetic field is kept better than 1 part in 10^7 . Instruments are now available for high resolution work and particular mention should be

made of Varian spectrometers. Studies on hindered internal rotations, proton exchange behaviour and determination of organic structures have been extensively carried out by employing NMR technique.

In the short span of a little over ten years time, NMR Spectroscopy has emerged out as a powerful tool for the study of the problems connected with matter in different states of aggregation. Its usefulness as a practical tool can be judged from the fact that it is already a commercial instrument and is used for

routine analytical purposes. We may expect a further widening of its applications in the years to come.

A. JAYARAMAN.

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ATOMIC STANDARDS OF LENGTH AND TIME

THERE is little doubt that atomic standards will serve to define the fundamental units of length and time within the next decade. They are already in wide use and are proving themselves not only more precise but far more convenient and accessible than the standards which are the bases of the present definitions. A recommendation to establish a metre equal to 1 650 763·73 vacuum wavelengths of the orange radiation ($2p_{10}-5d_3$) of the krypton atom of mass 86, is to be submitted in 1960 for formal approval by the 11th General Conference of Weights and Measures. Recent work indicates that the wavelength of the recommended line, $6057\cdot8021_1 \times 10^{-10}$ m. when emitted from the hot-cathode krypton lamp at 63° K. and corrected for the small departures from the ideally specified conditions of excitation, is reproducible to about 1 part in 10^9 .

There is some prospect of establishing the second of time in terms of the frequency of an atomic (or molecular) radiation, with a reproducibility of 1 part in 10^{10} , when the General Conference meets again in 1966. A line in the hyperfine structure of the caesium atom promised to be particularly suitable as a standard because its frequency near 9200 Mc./s. (wavelength 3 cm.), is very convenient for the electronic equipment. Moreover, caesium atoms are the easiest of all to detect, and they can be produced in a simple manner by heating to about 150° C. a mixture of caesium chloride and sodium. Rigorous tests carried out in the Standards Division, National Physical Laboratory, Teddington, on the caesium atomic clock since it was put into operation in 1955, have

given such convincing evidence of its reliability, reproducibility and ease of application that it is already accepted to be the most accurate of all standards of measurement, including the astronomical, for the unit of time interval. As at present established the frequency of this line of caesium, $F, m(4, 0) \rightleftharpoons F, m(3, 0)$ at zero field = $9192\ 631\ 770 \pm 20$ c/s.

Appropriate means will, however, need to be devised to correlate and harmonise, as and when found necessary, the units of time furnished by the astronomical and atomic standards. Both these must continue to be used, the former for the long term purposes of astronomy and the latter to meet the immediate needs of physics and radio-engineering. After many years have elapsed it should be possible to ascertain whether there is any difference between atomic and astronomical scales of time—a matter of some cosmological interest.

In the present state of knowledge there seems little hope of defining the fundamental unit of mass in terms of a natural standard, e.g., an elementary particle, atom or molecule, with the precision of 1 part in 10^8 ascribed to the existing material standard. Attention has been drawn, however, to the possible use of the gyromagnetic ratio of the proton as the means of defining a third basic unit (probably the gauss). This with the units of length and time, also depending on atomic characteristics, might provide in the future the stable foundations of a comprehensive system of measurement for all other physical quantities.—(H. Barrell, *Science Progress*, Vol. XLVII. April 1959, No. 186).

HYDROBIOLOGY SERVES FRESHWATER FISHERY IN NEW CHINA

CHANG TSUNG-SHEH

Hydrobiology Research Institute, Academia Sinica

CHINA is a country rich in freshwater fishery resources. According to incomplete statistical data, the total freshwater area (including rivers, lakes, ponds, etc.) amounts to about one million hectares. The Yangtze, Pearl and Amur rivers contain large quantities of fish. Lakes are dispersed all over the country, about 100 of them being large lakes of more than 10,000 hectares with far more medium and small-sized ones. All these are excellent for fishery. History records that as far back as the 5th century B.C. pisciculture existed in China. Endowed with the experiences of generations the Chinese selected and cultivated such delicious and fast-growing fishes as the *Mylopharyngodon* (Black carp), *Ctenopharyngodon* (Grass carp), *Hypophthalmichthys* (Silver carp) and *Aristichthys* (Big head). Freshwater pisciculture was always of considerable importance to China's national economy, producing about 30% of the total fish harvest.

SCIENTIFIC RESEARCH

Like all other branches of science, hydrobiology has progressed rapidly in New China with the development of freshwater fishery. The Institute of Hydrobiology of the Academia Sinica is the chief centre of the scientific research into freshwater fishery. The Institute was founded in 1950 at the same time as the Academia Sinica was established. In 1954, it was moved to the East Lake of Wuhan, capital of Hupeh Province, which is surrounded by lakes and ponds. Facilities now include a new research building, experimental fish ponds, hot house, motor boats and other equipment. There are at present more than 100 research and technical workers on the staff, including many well-known professors and specialists (Prof. Chia-chi Wang, Protozoologist, Director of the Institute, and Prof. Hsien-wen Wu, Ichthyologist, the Vice-Director) and a large number of young assistants. They are working on ichthyology, fish parasitology and bacteriology invertebrate zoology, the biology of freshwater plants (both high and low) and the chemistry of water.

LAKE SURVEYS

Most of China's lakes are distributed in the middle and lower Yangtze basin; one-fifth of the total freshwater area is located in Hupeh Province. In this region the temperature is above 20° C. for more than half the year and

frost is rare. Therefore the growing period of fish is longer and fry of various pond fishes are produced and collected in this area which is favourable to freshwater pisciculture. In order to gain a scientific basis for large-scale fish-cultivation, the properties of the lakes must first be studied. In 1953, a general survey was made under the leadership of Prof. Jao Chin-chih. Medium- and small-sized shallow lakes of Hupeh, Anhwei and Kiangsu provinces along the Yangtze River were investigated. The survey covered 658 lakes, having a total area of more than 600,000 hectares. Rich in water plants and plankton, combined with other chemical properties and ecological conditions, most of such lakes proved to be of eutrophic type, especially suitable for rearing the four famous Chinese pond fishes. Besides, lakes of a special type such as the Chinghai Hu (Koko-Nor in Chinghai Province) and its surrounding smaller lakes in the North-West and lakes of the Yunnan uplands were investigated for productive possibilities. Preliminary investigations were also made of the fishery potentials of several reservoirs on the Huai River.

PREVENTION AND CURE OF FISH DISEASE

Formerly, the death rate caused by epidemic diseases in pond fishes was very high, reaching 40%, 60%, and even 90%. Fish disease spelt serious disaster to the fish farmers. Since 1953, scientific workers, under the leadership of Prof. Da-shu Nie, have investigated the main fish diseases in the chief districts of pisciculture and effective ways of treatment have been found. For example, it was discovered that the parasitic diseases of the gill of the grass carp (*Ctenopharyngodon*) were caused by parasitic protozoa (*Cryptobia*, *Trichodina*, *Triphophrya*) and crustacea (of the family Ergasilidae), and it was found that a mixed solution of ferrous and cupric sulfates is an effective remedy. An efficacious way to kill *Argulus* is the use of 666 and bacterial gill and skin diseases of the grass carp can be cured by using bleaching powder. The gastrointestinal diseases of the grass-carp and black-carp also can be successfully controlled. With the aim of combining prevention and treatment, a series of piscicultural technological studies are being made (sterilising the fish ponds with lime, the use of mixed manure as fertilizer for raising natural fish food in ponds, and methods of fish fry transportation, etc.). The results of

these studies will play an important role in increasing pond productivity.

FISH PHYSIOLOGY, ECOLOGY AND ANATOMY

One of the key problems in freshwater pisciculture is to get fish fry. Up to now pond fish fry are procured from the rivers at a particular season of the year and then transported to other places for cultivation. There are many shortcomings in such a method: it is difficult to select and transport fry, it demands too much labour, the time for collection is too limited, etc. With the rapid development of pisciculture, the supply of fry will become to some extent a limiting factor. Inducing pond fishes to spawn in the stagnant waters of lakes or ponds is therefore of no little significance both theoretically and practically. Studies are being made to attack the problem from many sides (physiologically, biochemically and histologically). Some preliminary results regarding factors governing spawning have already been obtained.

The ecological survey of fish in the Liangtze Lake (458.5 square kilo metres), in Hupeh Province, has just been finished.

Detailed morphological studies of the carp are being made by Prof. Chi Ping (now of the Zoological Institute of the Academy).

Researches on planktonic, algæ, zooplankton, fish and fish parasites are being carried out and some results have been published. The plan is to continue these studies and to publish serial monographs.

The problem clearly set before the hydrobio-

logists is the difficult one of raising the total fish yield. At the heart of the problem is the productivity of water bodies, whose resources, reserves and productive capabilities must first be investigated. Therefore, surveys of various types of lakes throughout the country will be continued and at the same time permanent stations will be established. In order to raise the productivity of the medium and small-sized lakes, research will be conducted under the following headings: the growth of fish in relation to their natural food; the effect of artificial fertilization on water bodies; the chemistry of freshwater; the relationship between aquatic micro-organisms and productivity of water bodies; the prevention and treatment of fish diseases, etc.

The multi-purpose utilisation of rivers is being developed rapidly in this country; hydro-technical construction will deeply affect fishery in the basins. How to ensure that hydrobiological research is suited to the changing hydrological aspects daily assumes greater significance. The ecological survey of fish in the Yangtze and the Heilunkiang (Amur) rivers has already begun. Investigation into the productivity of large water reservoirs will begin soon. The question of water pollution by the many newly-built factories will be given due attention.

All this work is being carried out in accordance with the needs of China's economic construction and at the same time these are also problems of importance to hydrobiology.

CELL AS AN OBJECT OF EXPERIMENTAL STUDY

UNDER the auspices of the Department of Zoology, Presidency College, Calcutta, a symposium was held on the 3rd May 1959 on the "Cell as an Object of Experimental Study". The purpose of this meeting was to try and bring about a synthesis of the various aspects of study of the Cell. Considering that this was the first attempt made in this direction in India the results were quite encouraging.

The fifteen papers presented at the symposium were rather diverse but stimulating.

A typical example, of the possibilities of Biological experimentation, was offered by B. R. Seshachar's studies on *Spirostomum*. He reported that the macronucleus of this ciliate could be extended to as much as fifteen times the original length. More recent experiments have shown that, under high speed centrifuga-

tion, it presented the appearance of a system of parallel fibres, quite unlike its characteristic particulate appearance, in the vegetative state. The interest in this work lies in the fact that it fits into the present concept of the structure of DNA which makes up much of the ciliate macronucleus.

The behaviour of the cell, under different conditions, gives us an idea of the substances that are essential for the synthesis of the ultimate cell products, and those that are detrimental to it. C. De and M. Mukherjee, presented an analysis of the function of plasmalogen in different tissues like liver, kidney tubules, adrenals and testis. A number of experimental conditions, which alter hormonal activity in the last two organs, have been observed to affect the plasmalogen content also.

The importance of cell constituents like the microsomes was well brought out in the studies of liver and kidney by I. B. Chatterjee and his colleagues. These cytoplasmic inclusions contain all the enzyme systems for the conversion of either D-glucuronolactone or L-gulonolactone to L-ascorbic acid. The absence of L-gulonolactone in guinea-pig is thought to be due to a gene controlled enzyme disfunction.

In his work on reticulo-endothelial cells in tissue culture, J. Chatterjee showed that the antibody formation, initiated and continued by these cells, could be enhanced by certain vitamins or depressed by low temperatures.

It becomes more and more clear that for a complete investigation of any given material it is necessary to use not only the method of biology but of biochemistry and biophysics too. An example is found in the investigation of Sen and Biswas on auxin-induced growth in plants using P^{32} . Auxins, through increased activity of nucleotides, stimulate the synthesis of both DNA and RNA. Here both C^{14} and P^{32} were used as tracers.

A. Guha presented what he thought was evidence for the presence of a chromosomal organization in bacteriophage. S. P. Ray-Chaudhuri described his findings of radiation induced dicentric bridges. He showed that in grasshoppers kept in an atmosphere of more oxygen, radiation induced the production of

more bridges than those in an atmosphere of less oxygen.

Dr. Nandi's paper on Ultraviolet Radiation on *Aspergillus niger* showed that visible light is able to counteract damages, done to cells, by exposure to UV irradiation, the photoreactivation effect being maximum with sunlight.

P. De's contribution dealt with an analysis of growth and functionation in normal and malignant cells, while A. K. Sharma discussed the role of plant pigments in the production of breaks and other changes in chromosomes. S. Mookerjee showed how in Hydra, the interstitial cells could be stimulated to gonad differentiation by treatment with DNA.

Cytochemical studies on Protozoan parasites undertaken in the Calcutta School of Tropical Medicine were described by Dr. H. N. Ray. These studies have brought out the importance of the nucleic acids as well as cell enzymes in the metabolism of these animals. Asoke Ghosh dealt with the probable role of progesterone in the metabolism of the pigeons adrenal cortex. P. N. Bhaduri's contribution dealt with recent refinements in the methods of culturing excised paddy embryos and their bearing on experimental induction of polyploidy.

The symposium highlighted the importance of close collaboration among Biology, Biochemistry and Biophysics.

DISCOVERY OF A NEW ATOMIC PARTICLE: NEUTRAL- χ

THE discovery of a new kind of atomic particle was announced from the radiation laboratory of the University of California. Called the "Neutral- χ " particle, it is one of the unstable heavy mesons, several of which have been discovered in the last twelve years.

The discovery had been accomplished by shooting a beam of "K mesons" from the bevatron in Berkeley into a hydrogen bubble chamber. The latter is a tank of liquid hydrogen arranged in such a way that atomic particles passing through it leave behind a trail of minute bubbles which can afterwards be photographed.

Prof. Alvarez said that the particle which has been observed was produced by a collision between a negatively charged K meson and a proton in the bubble chamber. In the photograph this would have been represented by a sudden cessation in the track of the K meson; for the products of the nuclear reaction are electrically neutral and so leave behind no visible track of bubbles.

The proof of the formation of the χ -meson rested on the observation of the "neutral lambda" meson formed in its natural radioactive decay (which appears to take about a ten-millionth of a second). This is a remarkable technical feat, for the "neutral lambda" is itself electrically neutral and therefore not represented by a track in the bubble chamber. In fact it was only recognised by the observation of its own radioactive decay products.

From these experiments, Prof. Alvarez said, it had been concluded that the mass of the new particle (which is greater than that of a proton) was roughly 2,590 times that of a single electron. Within the accuracy of the experiment this is identical with the mass of the negatively charged χ -meson—one of the first of the heavy mesons discovered by a research group from Manchester University in 1947.

Prof. Alvarez also said that the new particle appeared to decay spontaneously (as it should) into a neutral lambda meson and a neutral π -meson.—*Science Newsletter*, 4718.

INHERITANCE OF LEAF BLOTCHING IN AN INTERVARIETAL CROSS OF *TRITICUM AESTIVUM* L.

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AT the Botany Division, Indian Agricultural Research Institute, New Delhi, an extensive collection of wheat varieties, both Indian and exotic, is maintained. These are critically assessed for disease resistance and other desirable agronomic characters for utilizing them as direct introductions or in hybridization work for wheat improvement. Among the recently received wheats from the U.S.A., a hybrid variety Supremo \times Montana (accession number, E. 1844), while showing high resistance to brown and yellow rusts, was found to develop symptoms of blotching in leaves during the two-year period for which it was under study.

Detailed observations on the development of blotching in leaves revealed that its symptoms first appeared in the older leaves about 50 days after the sowing of the crop and they subsequently spread also to younger leaves. The yellow-chlorotic spots occurred in patches at random in the leaves, their size being variable in the same leaf. At later stages, the tissues in these chlorotic zones dried up. When the incidence of such chlorotic patches was high, the whole leaf dried up. The leaves with typical blotching are shown in Fig. 1. The exact nature of this blotching, however, is not as yet known, though it has been established that the chlorotic patches are not caused by any fungus.

The variety, Supremo \times Montana, was crossed with New Pusa 718, which has normal green leaves, with a view to finding out if this character was genetically controlled. The mode of inheritance of this character was studied for two years. During the year 1956-57, the F_1 and the F_2 generations of the cross were grown while in the subsequent year, F_3 progenies were also added. Casual observations made during 1956-57 showed the dominance of normal green leaves over blotched leaves in F_1 and the segregation of the two characters in accordance with the simple Mendelian ratio in F_2 . During the year 1957-58, the F_1 , F_2 and F_3 generations along with parents of the cross were grown in three replications. It is of interest to note that, during this year as well, the parent E. 1844 developed characteristic blotching of leaves in all the replications, while N.P. 718 had normal green leaves. The F_1 data confirmed previous year's observations that blotching in the leaves

of E. 1844 was recessive to normal green leaves of N.P. 718. The segregations observed in the F_2 and F_3 generations are given in Tables I and II respectively.

TABLE I

The mode of inheritance of leaf blotching in the F_2 of the cross N.P. 718 \times E. 1844

Material	Number of plants			χ^2	P. value
	Normal green	Blotched	Total		
N.P. 718	..	155	..	155	..
F_1	..	119	..	119	..
F_2 Observed	..	183	77	260	2.95
Expected (3:1)	..	195	65	..	10--05
E. 1844	97	..	..

TABLE II

Segregation of leaf blotching in the F_3 of the cross N.P. 718 \times E. 1844

Material	No. of families			Total	χ^2	P. value
	Homozygous green	Heterozygous (3:1)	Homozygous blotched			
F_3 Observed	..	4	9	7	20	..
Expected	..	5	10	5	..	1.1
(1:2:1)	..	5	10	5	..	.95--90

In the F_2 , a large variation in the intensity of blotching was observed (Fig. 1). However, when all the plants showing even slight development of yellow spots were grouped together and compared with the normal green plants, the segregation showed a good fit to a monohybrid ratio of 3 normal: 1 blotched.

In the F_3 , the segregation among the families showed a good fit to a ratio of 1 homozygous green: 2 heterozygous: 1 homozygous blotched. A further analysis of heterozygous families in this generation showed them to segregate in a ratio of 3 normal green: 1 blotched. The F_2 and F_3 data, therefore, prove conclusively that

blotching in leaves of wheat variety Supremo \times Montana behaves as a recessive to normal green leaves of N.P. 718 and is inherited in accordance with a monohybrid ratio.

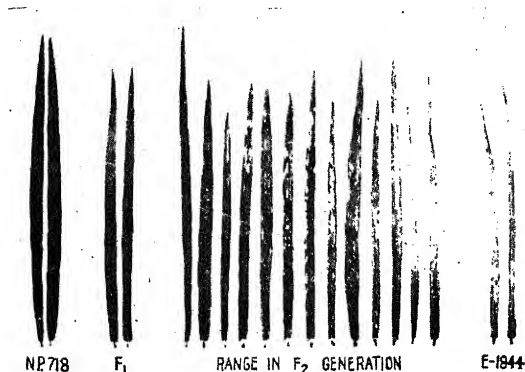


FIG. 1

With a view to finding out the association, if any, between blotching and grain yield, the F_2 data were subjected to 't' test. The results are summarized in Table III.

TABLE III

Grain yield comparison of normal green and blotched plants in the F_2 of the cross

N.P. 718 \times E. 1844

Material	Mean grain yield per plant (gm.)	Difference	't' value	P. value at 5% level
Normal green plants	17.84 \pm 0.8217	..	..	..
Blotched plants..	17.12 \pm 1.1345	0.72	0.489	1.959

It will be observed that the blotched-leaved phenotypes had slightly lower mean yield than the normal green-leaved phenotypes, though the difference between them was not significant statistically.

As far as the authors are aware, the occurrence of blotching in wheat varieties has not been reported before. Further work is in progress to find out the nature of blotching in the leaves of variety Supremo \times Montana.

PHYSICAL PROPERTIES OF LIVING PROTEINS

ACCORDING to a report given by Soviet Scientist Prof. Lev Blumenfeld, living proteins have physical properties very similar to those of metals and a large group of substances, including ferrites, widely used in making mechanical memory devices and radio apparatus. The ferromagnetic properties of living proteins were discovered by means of an electronic paramagnetic resonator.

The essence of the phenomenon discovered is that living proteins can conduct electricity and are capable of magnetic polarisation similar to that which takes place on ferrites in mechanical memory devices. Experiments have shown that proteins and nucleic acids have no such properties when separated from each other. But as soon as these two polymers are combined they develop this property. A huge cloud of free (non-paired) electrons, up to 10,000 per molecule, is observed in the molecules of living proteins.

The experiments were conducted for a year with various preparations of the nucleic acids

and natural proteins. It was established that the new phenomenon is much more pronounced in the experiments with younger, rapidly-growing tissues and with tissues of the marrow and the brain than in the experiments with artificial preparations.

Commenting on Prof. Blumenfeld's report, Acad. Kapitza pointed out that no one among the physicists who had worked on theory in this field had expected it to help to explain the basic phenomena of life.

The experiments carried out by Prof. Blumenfeld and his assistants open up a new way of studying the physical basis of life. The studies of the new phenomenon may even help to get a deeper insight into the laws of heredity and to understand the mechanism by which living matter "memorises" the so-called genetic code. This mechanism may, to a certain degree, be similar to a very complicated magnetic recording. Human memory probably has the same physical basis.—Soviet News.

LETTERS TO THE EDITOR

EFFECT OF SYNTHETIC SOIL
CONDITIONERS ON THE CATION
EXCHANGE CAPACITY OF SOILS
AND CLAYS

RESULTS of previous workers¹⁻⁸ in this field show that cation exchange capacities of soils and clays may be affected by treatment with synthetic polyelectrolytes but their nature and extent remain purely conjectural, thus requiring further detailed studies. The present investigation was undertaken to find out the effect of three synthetic polyelectrolytes on the cation exchange capacity of typical Indian soils and clays.

Kriliium Loamaker (100% active) supplied by Monsanto Chemical Co., U.S.A., hydrolysed polyacrylonitrile (HPAN) and a copolymer of styrene and Maleic acid (SMA) prepared by us were treated at the rate of 0.1% on dry basis with alluvial soil, black cotton soil (Nagpur), a soil rich in organic matter (Jalpaiguri) and bentonite and Rajmahal (Kaolin) clays (supplied by Calcutta Mineral Supply Co., Calcutta) under laboratory conditions. Soil conditioners were applied in a requisite amount of aqueous solution ($\frac{3}{4}$ P.L.) by directing a fine spray into 250 g. of soils passing through 2 mm. round holes and clays (300 mesh). The whole quantity was thoroughly mixed and kept in suitable containers provided with lids. After treatment for 48 hours, the samples were gently passed through a 4 mm. sieve and air-dried. Each experiment and control was replicated four times and the average values are given in Table II. Cation exchange capacity was determined by ammonium acetate method.⁹

TABLE I
Physical properties of soils and clays

Soil or clay	Conductivity $10^{-8} \times \text{mhos}/\text{cm. at } 25^\circ \text{C.}$	Moisture content per cent.	Sticky point	Porosity	Cation ex- change capa- city M.E./100 g.
Alluvial soil	.. 2.05	1.976	22.63	51.92	13.46
Black cotton soil (Nagpur)	6.00	6.836	22.98	42.39	61.45
Soil rich in organic matter (Jalpaiguri)	0.24	1.720	..	57.02	12.18
Rajmahal clay (Kaolin)	1.36	0.852	23.14	54.77	20.02
Bentonite	.. 8.25	11.53	23.87	47.59	62.51

TABLE II

Effect of synthetic soil conditioners on the
Cation Exchange Capacity of soils and clays

Treatment	Cation exchange capacity M.E./100 g.				
	Alluvial soil	Soil rich in organic matter (Jalpaiguri)	Black cotton soil (Nagpur)	Rajmahal clay (Kaolin)	Bentonite
Untreated	.. 13.46	12.18	61.45	20.02	62.51
Kriliium	.. 14.69	20.90	60.94	14.90	59.54
SMA	.. 12.77	10.83	51.61	20.37	62.82
HPAN	.. 12.65	13.83	52.19	10.20	62.96

The figures in Table II show that the cation exchange capacity of bentonite clay and alluvial soil is not appreciably altered by any of the three treatments. Similarly no marked change is observed in the cases of soil rich in organic matter (Jalpaiguri) treated with HPAN and SMA Black cotton soil (Nagpur) treated with Kriliium and Rajmahal clay treated with SMA. However, Rajmahal clay with Kriliium and HPAN, and Black cotton soil (Nagpur) with SMA and HPAN show a decrease in cation exchange capacity. The only case of increase is in the Kriliium treatment of Jalpaiguri soil.

Minorulkeda⁵ and Allison⁸ studied the effect of soil conditioners on the cation exchange capacity of soils and reported increases in all cases. Archibald and Erickson⁶ reported both increases and decreases from 0.02% VAMA treatment. However, Mortensen and Martin⁷ reported that the cation exchange capacity of Hoytville silty clay was not altered by VAMA or HPAN treatment when applied at the rate of 0.12%. The present results show that no generalization regarding the changes in cation exchange capacity, as a result of treatment with synthetic polyelectrolytes, could be made. Evidently such changes are governed by (1) nature of the soils and clays, (2) nature of the polyelectrolytes and (3) concentration of the polyelectrolytes.

Thanks are due to Prof. Santi R. Palit, Professor of Physical Chemistry, for helpful criticism and suggestions and also to Prof. R. Ray,

Director, Indian Association for the Cultivation of Science, for providing laboratory facilities.

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A SIMPLE LIQUID AIR TRANSFER VALVE FOR CONTROLLED EVAPORATION

IN connection with the installation of our helium liquefier we had to construct a siphon together with a liquid air transfer valve for transferring liquid air into partially evacuated system. On looking into the literature we found a liquid hydrogen transfer valve described¹ which is, however, too complicated for our purpose. Our main requirements are: (1) a long operating handle to prevent the freeze up of the valve, (2) a vacuum-tight seating of the valve which could easily open when there is a vacuum on the outlet side. We have therefore designed and constructed a very simple liquid air transfer valve meeting the above requirements.



Fig. 1. Sectional View of the Transfer Valve.

H = Operating Handle. G = Fibre Gasket.
P = Piston. E = Entry Port.
K = Stainless Steel Knob. O = Liquid Air Outlet.
S = Phosphor-bronze Seat.

The constructional details of the valve can be easily followed from Fig. 1. The outer sheath

of the whole assembly (shown shaded) is made of stainless steel which carries the long hollow piston P (also of stainless steel) operated by the handle H. The piston moves over a small distance of a few mm., the clearance between the piston and the outer sheath being very small, of the order of one mm. or less. K is a stainless steel knob, which slides loosely into the piston P but presses tightly against the phosphor-bronze seat S. E is the entry port for the liquid air, which is connected to the liquid air supply system through conventional type of fittings, such as petrol unions, etc. O is an outlet similarly connected by a siphon to the system, in which the liquid air is to be kept continuously evaporating at reduced pressure.

For starting the transfer, the piston is moved back when the liquid air enters through E, pushes the knob K and goes to the outlet O. The piston is kept in the horizontal position so that the force required to transfer the liquid has not to work against the weight of the knob, and is, therefore, considerably minimised. After the required amount of liquid has been transferred into the evaporation chamber, the piston is brought back to close the valve.

The design has the following special features:—

(1) Long and convenient size of the piston: As the threaded part of the piston is at a great distance any chance of the valve being blocked or jammed is considerably minimised.

(2) Vacuum-tight connections: The stainless steel knob and the phosphor-bronze seat enable a high vacuum to be obtained evaporating at a pressure of a few mm. of mercury. The mechanical seating of the valve is quite robust ensuring it a long life even in rough use.

Several such valves are in continuous use in our laboratory for feeding liquid air and have been found to be entirely satisfactory in operation. To minimise heat influx into the valve the portions near E and O are surrounded by glass wool.

The author wishes to express his thanks to Prof. B. N. Srivastava for his helpful discussions.

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INFLUENCE OF EXTERNAL ATMOSPHERE ON A/C SILENT DISCHARGES

WHILE investigating the effect of light on A/C silent discharge, it was noticed that the results were not always reproducible. For example, the current voltage and the negative light-effect voltage characteristics differed considerably at different conditions of the atmosphere surrounding the discharge tube. It was therefore thought advisable to study the effect under conditions where the latter could be controlled.

With this object in view the usual type of discharge tube was modified so as to have a coaxial glass enclosure which could be evacuated. The inner discharge tube contained iodine vapour and was fitted with two sleeve electrodes, of a few turns of copper wire each, kept at about 5 cm. apart. The electrode leads were brought out by sealing them through the glass of the envelope. The whole apparatus was heated to a temperature of about 400°C . and the envelope was evacuated and sealed off. After the discharge tube was cooled to the room temperature it was tried for the effect of light on A/C silent discharges using the conventional circuit.

A typical result obtained under these conditions is shown in Fig. 1. It is clear from the

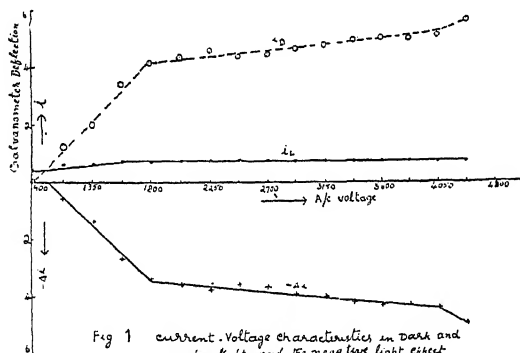


Fig 1 current-voltage characteristics in dark and under light and the negative light effect

figure that after the threshold potential the discharge current in dark (i_d) increases rapidly with the voltage up to a certain value and afterwards the rate of increase is reduced so much that the current characteristic is almost parallel to the X axis. This state continues throughout the voltage range available. The discharge current under light (i_l) in the negative light effect region showed a constant value making its characteristic parallel to the X axis. The negative light effect ($-\Delta i$) being equal to ($i_d - i_l$) follows the characteristic of the discharge current in dark (i_d).

Earlier observations of Joshi and Cherian,¹ and Khastgir and Setty² showed that at a constant pressure the magnitude of the photo suppression ($-\Delta i$) first increased with the voltage reaching a maximum and then diminished. But the present results do not support the above findings. The decrease of the negative light effect ($-\Delta i$) noticed in the previous investigations may perhaps be due to the effect of the atmosphere surrounding the discharge tube which in the present case has been reduced to a vacuum.

Also it may be mentioned that under the new experimental conditions there was no indication of the effect of ageing reported by earlier workers.³⁻⁵ The discharge current as measured by the galvanometer remained practically the same whenever the readings were taken, and the light effect could be observed even when the discharge tube was kept unused for a few months.

The results of the present work appear to point to a method by which consistent results, in investigations of the light effect on A/C silent discharge current, can be obtained. Further work is in progress.

My grateful thanks are due to Prof. S. B. Bondade, for his encouragement, help and facilities. Thanks are also due to Dr. S. Ramaswamy, and to the Ministry of Scientific Research and Cultural Affairs.

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THE PHOTOLYTIC PREPARATION
OF AMMONIUM-URANIUM (IV)
FLUORIDE MONOHYDRATE COMPLEX

THE isolation of uranium tetrafluoride, as the product¹ of photolysis of Uranyl Salts in aqueous hydrofluoric acid medium, led us to investigate the product when ammonium bifluoride is used in place of HF. On exposure of an aqueous solution of 100 c.c. containing 3.0 gm. of uranyl

formate and 7.0 gm. of ammonium bifluoride or 3.5 gm. of uranyl nitrate, 7 gm. of ammonium bifluoride and 10 c.c. of alcohol, to sunlight for about four hours, uranium was quantitatively precipitated in the form of fine green crystals. The precipitate was filtered, washed with distilled water followed by alcohol and dried in an air-oven at 100° C., for an hour after which the analysis was carried out.

The molecular weight of the compound was determined from the U_3O_8 content of a weighed quantity of the substance. This was brought about by dissolving a known quantity of the substance in 8N NCl and precipitating the hydrated oxide by NH_4OH and heating the precipitate, after filtration, to U_3O_8 in a platinum crucible. The filtrate was used for the estimation of fluorine as CaF_2 by the method developed by Badeeva.² By using Hatt's³ method along with the Jones reductor method,⁴ the entire uranium has been found to be present in the uranium (IV) state. Volumetric estimation of fluoride by modified thorium nitrate method developed in this laboratory⁵ was also carried out. Ammonia content of the compound was determined by Kjeldahl's method. The analytical data establish the formula of the compound to be $NH_4F \cdot UF_4 \cdot 1 H_2O$. Khlopin and Gerling⁶ prepared the compound $NH_4F \cdot UF_4 \cdot 0.5 H_2O$ by adding NH_4F to a solution of uranium (IV) salt in aqueous hydrofluoric acid.

The expeditious removal of uranium in the form of this complex by the utilization of solar energy has been applied in this laboratory for the separation of uranium from a number of other elements. This as well as the details of the complex will be published elsewhere.

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SEPARATION AND ESTIMATION OF TOBACCO ALKALOIDS BY PAPER CHROMATOGRAPHY

THE extensive use of tobacco and tobacco alkaloids has stimulated interest in the development of micro and semi-micro methods of separation and estimation of the individual components of these alkaloids.

Separation and estimation of nicotine, nicotine, anabesine, anatabine and nor-nicotine have been effected by two-dimensional paper chromatography from the hydrochlorides of the alkaloids. These alkaloids were obtained from tobacco extract prepared from a mixture containing equal proportions of mild and strong tobacco for smoking and tobacco leaves for chewing.

A finely ground powder of the mixture was soaked in distilled water (ratio 1 : 4 by weight), stirred periodically and filtered after 72 hours. The alkaloidal hydrochlorides, prepared by treating the extract with conc. HCl was then neutralised with excess of 6% NaOH in 60% ethyl alcohol and then mixed with $CaCO_3$. The alkaloids were then repeatedly and completely extracted with ether, till the residue no longer gave a golden yellow colour by treatment with 1.0 c.c. of cyanogen bromide and 0.2 c.c. of 2.5% analine in water solution. The ether extract was then treated with 10% HCl and the alkaloidal hydrochlorides dried under high vacuum.

Taking into view the observations of Munier and Mocheboeuf¹⁻⁴ (1949, 1950, 1951) and Carless and Woodhead⁵ (1951) that the shape of the spot depended on pK, solubility of the alkaloid and on pH of the solvent, a buffered (M/10 Phosphate) Whatman No. 1 paper 40 × 40 cm. and solvent, a modification of Werle and Koch⁶ (1951) consisting of *n*-butanol and acetic acid (85 : 15 v/v) for one dimension and *n*-butanol, ammonia and water (90 : 2 : 8 v/v) for the other dimension, were used. The chromatogram was run at 20° C. for 16 hours in each of the dimensions and then dried first in a stream of warm air and finally in an air-oven at 45° C. for 20 minutes.

The spots on the chromatograms were detected by the action of vapour of cyanogen bromide followed by a treatment with 0.25% benzidine solution in alcohol, and observation in ordinary and ultra-violet lights. The R_f values (see Table I) of these alkaloids were then calculated and compared with the values obtained from several control chromatograms prepared under identical conditions.

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The quantitative estimation was made by elution of coloured spot and colorimetry, and the amounts of the different alkaloids were found to be higher in the strong sample of tobacco as would be seen from the table.

TABLE I

R_f values and Quantities of tobacco alkaloids in mild and strong samples

Serial No.	Name of the alkaloid	<i>R_f</i> value	Quantities in mg. 100 g. of sample	
			Mild tobacco	Strong tobacco
1	Anabesine	.. 0.21	22.3	26.0
2	Nicotine	.. 0.23	19.0	23.0
3	Nicotimine	.. 0.30	17.6	18.1
4	Nor-nicotine	.. 0.26	10.2	10.7
5	Anatabine	.. 0.34	15.5	16.6

The total alkaloidal content in dried mild and strong samples of tobacco was found to be 0.124 and 0.155% w/w respectively in the different samples analysed. The presence of these alkaloids was further confirmed by the preparation of picrate, methyl iodide and platinum-chloride derivatives and by polarographic studies.

Alkaloids present in quantities below 0.5 mcg. could not be characterised. The coloured spots were close to one another on the chromatograms. The *R_f* values of nicotimine and anatabine showed some fluctuation, obviously due to contamination with other alkaloids.

Chemical Laboratory,
Medical College,
Agra, November 7, 1958.

A. SINHA.

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AN ELECTROPHORETIC STUDY OF TISSUE CULTURE FLUID FROM NORMAL AND IMMUNOGENIC LIVER CELLS IN CULTURE

ANTIBODY formation in immunised mice liver cells in tissue culture, shown by antiglobulin test and inhibition or enhancement of such antibody formation, have been reported.^{1,2} The

object of the present work was to study the culture fluid from immunogenic and normal cells by electrophoretic means, and see if there was any difference between the fractions from these.

The immunisation in the present experiment has been done with azo-protein, after the method described by Landsteiner and Vander Scheer.³ The method of tissue culture, both control and experimental, and the collection of culture fluid, after 48 hours of culture, were essentially the same as described in.^{1,2} For the present study a culture fluid control where the fluid did not have any explant has also been incubated and used for electrophoresis. Simultaneous runs were given with (i) Blank media in culture fluid control, (ii) Normal liver culture fluid, (iii) Immunised liver culture fluid and (iv) Normal liver culture fluid kept at -12° C. for 48 hours. The spotting in each case was done with 0.01 c.c. of the fluid using veronal buffer 0.1 M (pH = 8.6). The electrophoresis was done at 110 volts in an Elphor paper electrophoresis apparatus. The staining of the paper was done with 0.1% bromophenol blue in ethyl alcohol saturated with mercuric chloride for half an hour, washed with 0.5% acetic acid for 20 minutes and after drying at 60° C., densitometric readings were taken in a photovolt densitometer (model 425) and the percentages of different fractions were made by planimeter.

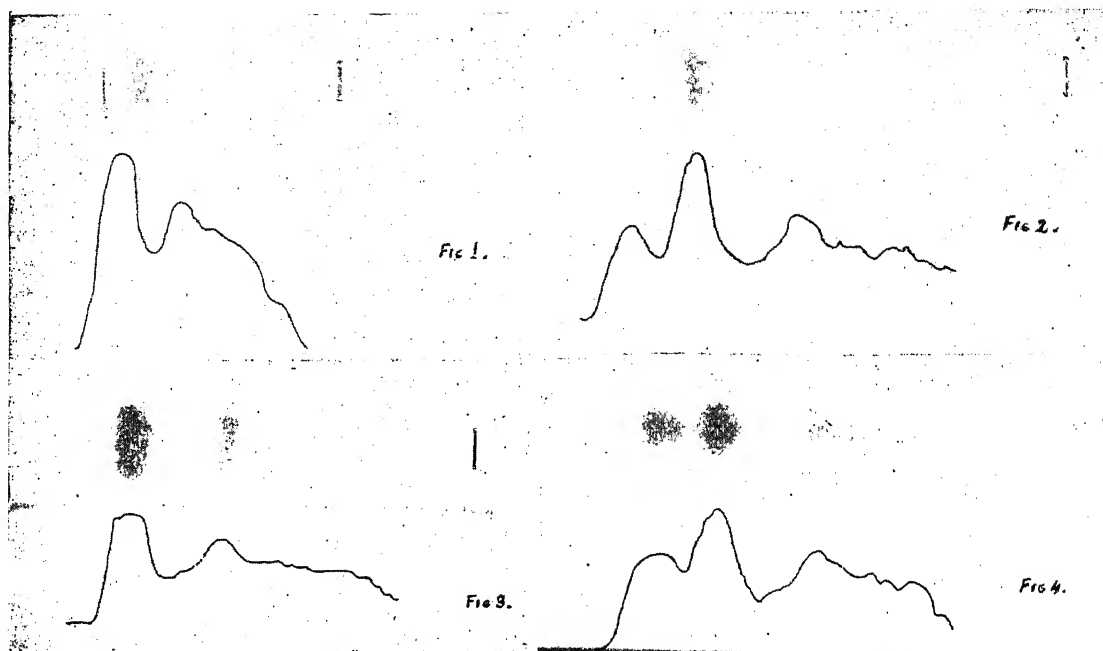
The mobility and the relative percentage of the different fractions, as determined from densitometric analysis, are shown in Table I. Figures 1-4 give photographic records of the fractions. It will be seen from Table I that both immunised and control liver culture fluid have a separate fraction having greater mobility.

TABLE I

Type of experiments	Fraction 1	Fraction 2	Fraction 3	Fraction 4
Azo protein immunised liver culture fluid	15.55%	32.04%	23.64%	28.77%
Normal liver culture fluid	20.8%	28.50%	28.20%	22.50%
Culture fluid blank	Nil	30.02%	33.11%	36.87%
Liver culture kept at -12° C.	Nil	37.46%	31.11%	31.43%

Fraction 1 is the most mobile and fraction 4 is the least mobile.

The significant finding from these experiments is the presence of the most mobile fraction obtained from the liver cultures. This fraction



FIGS. 1-4

Fig. 1. Liver culture at -12°C . Fig. 2. Azo-protein injected mice liver culture. Fig. 3. Culture fluid. Fig. 4. Normal mice liver culture.

however is conspicuously absent from the media control and from cultures kept at -12°C . Electrophoretic study along similar lines has mostly been directed towards finding the different fractions of the serum under different disease conditions. Key⁴ pointed out the value of electrophoretic method in distinguishing the causes of ascitis. Serum proteins were electrophoretically studied by Seibert, Seibert, Atno and Campbell⁵ in pulmonary diseases. Flynn⁶ and Hardwick⁷ have studied the electrophoretic pattern of serum in other disease conditions. Most of these studies have been directed towards finding the proportions of globulin fraction. Attention has not been focussed to the fast moving (veronal buffer pH=8.4) fraction, which has been found in the present experiments. This fraction, although not identified properly, is likely to be a pre-albumin fraction or a protein degradation product as shown by its mobility at the said conditions. Further work is in progress.

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SOME IMPORTANT CHARACTERISTICS OF GENUINE BETEL-NUT

IN view of the widespread adulteration of betel nut, *Areca catechu*, Linn. (Palmae) and absence of standard for it in the Prevention of Food Adulteration Act, 1954, experiments were carried out to find some of the important characteristics of genuine betel-nut so that its adulteration with the spurious nut (*Ramsupari*) may be detected.

A number of samples of Indian and imported genuine whole betel-nut and cut piece of betel-nut adulterated with '*Ramsupari*' were procured from the local market, converted to 40 mesh

TABLE I

Sample of betel-nut	Moisture % (Average)	Per cent. on dry basis						
		Total ash	Water extract	Alcohol extract	Ether extract	Quercitannic acid	Arecoline	Areca-red
Genuine, small (Indian)	10.5	1.4-1.7	25.4-29.4	36.0-42.4	10.0-12.3	21.1-23.0	0.28-0.35	12.8-16.2
Genuine, big (Indian) ..	8.8	1.4-1.8	26.4-27.2	37.0-46.2	12.6-17.0	16.5-24.2	0.34-0.36	11.0-12.1
Genuine, Extra big (Singapore)	8.9	1.4-1.9	28.1-32.5	42.2-44.4	13.9-15.8	21.3-25.8	0.47-0.54	6.0-6.9
Spurious nut (<i>Ramsufari</i>)	10.8	0.9-1.2	13.1-19.4	7.2-18.5	0.9-1.5	9.5-11.2	0.02-0.04	2.0-5.0

powder, subjected to the estimation of moisture, total ash, water extract, alcohol extract, ether extract and crude fibre by standard methods¹ and to the estimation of the volatile liquid alkaloid arecoline, $C_8H_{13}O_2N$ by the volumetric method.² Areca-red was estimated by extracting 1 g. of power with 100 ml. of 0.2% aqueous solution of sodium hydroxide under reflux and subsequent precipitation by dilute hydrochloric acid (1 + 2). The precipitates after filtration were washed well and dried at 100° C. to constant weight. Quercitannic acid was estimated by the standard method.³

The results are given in Table I.

The values of crude fibre have not been incorporated in the table as they are found to be of no significance. It is evident from the table that the bigger the nut the greater is the yield of ether extract and arecoline, whereas it is the reverse in the case of areca-red. Moreover, almost all the constituents determined here are much helpful to distinguish between genuine and spurious betel-nuts, and to fix a suitable standard for the nut.

Our thanks are due to Dr. S. K. Ghose, the Public Analyst, for facilities provided during the investigation.

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OCCURRENCE OF *AZOTOBACTER* *BEIJERINCK* AND *BEIJERINCKIA* DERX IN ACID SOILS OF INDIA

DURING a study of the distribution of *Beijerinckia* Derx in some fifty acid Indian soils from Assam, Tripura, West Bengal, Bihar, Madras, Kerala and Bombay, *Azotobacter chroococcum* was observed unexpectedly in a large number of soils. In the following table, the relative distribution of the organisms of both the genera in the soils studied is given:

TABLE I
Relative distribution of *Azotobacter* spp. and
Beijerinckia spp. in Indian soils

	Per cent. of total number of soils	pH range of soils
Soils where <i>Azotobacter</i> spp. occurs	54	4.4-6.4
Soils with doubtful occurrence of <i>Azotobacter</i> spp.	22	4.2-5.8
Soils where <i>Beijerinckia</i> spp. occurs	40	4.2-6.4
Soils where both <i>Azotobacter</i> spp. and <i>Beijerinckia</i> spp. occur	26	4.4-6.0

It may be seen from the table that in India *Azotobacter* spp. is more widely distributed in acid soils than *Beijerinckia* spp. though the occurrence of the latter is believed to be favoured by acid soils.

Ordinarily, *Azotobacter* spp. rarely occurs in soil with a pH lower than 6.0 (Gainey, 1927; Burk et al., 1934; Chang, 1940; Kaila, 1954). From time to time, however, isolation of acid tolerant species of *Azotobacter* has been reported (Subramoney, 1940; Maltchewsky, 1948; Tchan, 1953; Blinkov, 1955; Jensen, 1955). In this study, twenty strains of *Beijerinckia* have been isolated belonging to one species, *Beijerinckia indicum* and one variety *B. indicum*

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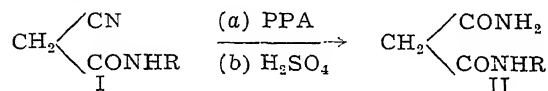
var. *alba*. Contrary to the findings of earlier workers that occurrence of *Beijerinckia* spp. is restricted to tropics and to laterite soils alone (Kauffman and Toussaint, 1951; Tchan, 1953; Kluyver and Becking, 1955), many of the present strains have been isolated outside the tropics from soils other than laterites and lateritic formations.

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Indian Agricultural Research Institute,
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PARTIAL HYDROLYSIS OF SUBSTITUTED AMIDES OF CYANACETIC ACID BY (A) POLYPHOSPHORIC ACID AND (B) SULPHURIC ACID

NITRILES have been hydrolysed to amides by Snyder and Elson¹ using polyphosphoric acid. Sperber *et al.*² prepared trisubstituted acid amides from corresponding nitriles using 80% H₂SO₄ at 100° C. Thus, the substituted amides of cyanacetic acid undergoing partial hydrolysis have been converted to corresponding malon mono amides, on separately using (a) polyphosphoric acid and (b) sulphuric acid. The process is as follows:—



(where, R is phenyl, tolyl, etc., groups).

(a) 0.01 M substituted cyanacetamide I, was dissolved in a clear solution of PPA, obtained by dissolving 10 gm. P₂O₅ in 6 c.c. phosphoric acid (1.75 d.) and heated for 2 hours at 110° C. The reaction mixture on pouring in water, gave white product, which was crystallised from

alcohol-water and it was found to be corresponding malon mono amide II.

(b) 0.01 M same cyanacetamide I, was dissolved in 10 c.c. ice-cold 75% sulphuric acid and the reaction mixture was kept overnight at room temperature. It was then poured in water and white product was obtained. This, on crystallisation as above, gave the same malon mono amide II.

The yields by both methods were almost quantitative; but in (b) the products were more clean and this method is relatively simple. These malon mono amides II have been found identical with the authentic samples prepared by Whiteley's³ method modified by Naik⁴ and his collaborators. Further work on the above amides is in progress and details will be published elsewhere.

Chemistry Department,
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December 23, 1958.

C. M. MEHTA,
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DRAINAGE PATTERN ON EITHER SIDE OF ARCHAEAN-CUDDAPAH BOUNDARY

IN the course of geological mapping in parts of Cuddapah Basin in Peninsular India, geomorphological studies were also made¹ with special reference to the pattern of drainage in the areas mapped. The area chosen for a detailed study of the drainage pattern lies between N. Latitude 14° and 15° and E. Longitude 77° 33' and 78° 30' in parts of Anantapur and Cuddapah Districts of Andhra Pradesh, in G.T.S. toposheets 57 F/9 to 16 and 57 J/1 to 8. The Archaean-Cuddapah geological boundary runs roughly N.W.-S.E. through this area for a distance of about 70 miles.

In the map covering this area, all the major intrusives such as dykes (16 in number) and brecciated quartz veins (6 in number) are marked. Table I gives the data on these intrusives.

Within the Cuddapah Basin the general attitude of the strata are noted (Table II) at various places and plotted. The dip of the

TABLE I

Regrouping of data on the attitude of the dykes and quartz veins in Archæans

Range of attitudes	Nos.
W.N.W. to N.W.	.. 3
N.W. to N.N.W.	.. 7
N.N.W. to N.	.. 2
N. to N.N.E.	.. 2
N.N.E. to N.E.	.. ..
N.E. to E.N.E.	.. 3
E.N.E. to E.	.. 5

strata is towards north, north-east or east depending upon the strike.

TABLE II

Regrouping of data on the attitude of strata in Cuddapah Basin

Range of attitudes	Nos.
N. 1° to 10° W.	.. -
N. 11 to 20 W.	.. 4
N. 21 to 30 W.	.. 9
N. 31 to 40 W.	.. 1
N. 41 to 50 W.	.. 26
N. 51 to 60 W.	.. 12
N. 61 to 70 W.	.. 1
N. 71 to 80 W.	.. 1
N. 81 to 90 W.	.. 1
N. 41 to 50 E.	.. 3
N. 71 to 80 E.	.. 2

The directions of flow of almost all the streams in this area (60 each over the Archæans and the Cuddapahs) were noted separately from one inch to a mile G.T.S. toposheets (Tables III and IV). Tributaries less than four miles in length were neglected since there is a possibility that most of them might have been guided more by gradient than by structural element.

TABLE III

Regrouping of data on the directions of flow of streams over the Archæans

Direction of flow	Nos.	Direction of flow	Nos.
N. 1° to 10° E.	4	S. 61° to 70° E.	3
N. 11 to 20 E.	4	S. 81 to 90 E.	4
N. 21 to 30 E.	4		
N. 31 to 40 E.	3	S. 21 to 30 W.	1
N. 41 to 50 E.	5	S. 51 to 60 W.	1
N. 51 to 60 E.	1	S. 71 to 80 W.	1
N. 61 to 70 E.	2		
N. 71 to 80 E.	2	N. 1 to 10 W.	5
N. 81 to 90 E.	5	N. 11 to 20 W.	3
		N. 21 to 30 W.	1
S. 1 to 10 E.	1	N. 31 to 40 W.	2
S. 21 to 30 E.	1	N. 41 to 50 W.	1
S. 41 to 50 E.	1	N. 51 to 60 W.	1
S. 51 to 60 E.	2	N. 81 to 90 W.	1

TABLE IV

Regrouping of data on the directions of flow of streams over the Cuddapahs

Direction of flow	Nos.	Direction of flow	Nos.
N. 1° to 10° E.	2	S. 51° to 60° E.	2
N. 11 to 20 E.	1	S. 61 to 70 E.	2
N. 21 to 30 E.	2	S. 71 to 80 E.	3
N. 31 to 40 E.	7	S. 81 to 90 E.	4
N. 41 to 50 E.	6		
N. 51 to 60 E.	6	S. 21 to 30 W.	1
N. 61 to 70 E.	5		
N. 71 to 80 E.	1	N. 11 to 20 W.	2
N. 81 to 90 E.	7	N. 31 to 40 W.	1
		N. 41 to 50 W.	1
S. 31 to 40 E.	2	N. 51 to 60 W.	2
S. 41 to 50 E.	1		

Following the pattern of graphical representation of strike and dip of joints as given by Billings,² the directions of the run of the dykes (16) and brecciated quartz veins (6), as well as those of the strike of the Cuddapah strata were plotted in two separate semicircles

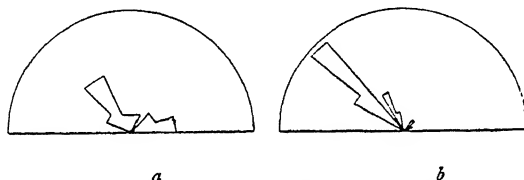


FIG. 1. Attitudes. (a) Dykes and Quartz veins; Archæans. (b) Strata; Cuddapahs.

(Figs. 1 a, 1 b). The directions of flow of the streams were subjected to a similar analysis and they were also plotted in two different circles (Figs. 2 a, 2 b).

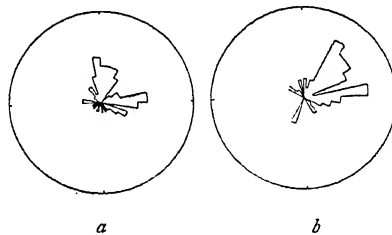


FIG. 2. Drainage. (a) Archæans; (b) Cuddapahs.

From Fig. 1 a it is evident that more than half of the intrusives run N.W.-S.E. and the others E.-W. with a negligibly few in other directions. Most of the streams over the Archæans (Fig. 2 a) are seen to flow either towards north or towards east. This might be due to certain structural elements in the granitic terrain, roughly in these directions. It was observed

in the field that there are major joints in the granites trending N.W.-S.E. and E.-W. Since the ultimate direction of slope is towards north, even those with initial direction of flow due N.W. or N.N.W. had to slowly turn towards north or north-east. It is surmised that the major joints here might have been responsible for the above directions of flow of these streams. There are numerous examples of joints having been cited as responsible for the drainage pattern in different areas.³⁻⁵

In the second case (Fig. 1 b), the strike of the rocks varies from N.W.-S.E. to W.-E. and almost all the streams are seen to flow (Fig. 2 b) north-east and a few to the east. To get at a better picture of the pattern of drainage in this part of the area, the attitudes of the strata nearest to streams were also noted and the nature of the stream⁶ arrived at, namely, if it is a consequent, subsequent or obsequent stream. It is found that about 40 of them are consequents, about 15 subsequents and only 3 obsequents.

Thus it is seen that joints control the drainage pattern in the Archæan terrain and the attitude of strata, in the Cuddapah Basin.

My grateful thanks are due to Prof. C. Mahadevan for his interest in this work.

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December 31, 1958.

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AN IMPROVED TITRATION VESSEL FOR IODOMETRIC ESTIMATION OF REDUCING SUGARS

In the estimation of reducing sugars by the iodometric procedure,^{1,2} a 25 mm. O.D. × 200 mm. tube has been suggested for titration. Such a tube with a comparatively narrow mouth has to accommodate the burette nozzle and also a stirring rod, which entails a little discomfort when several estimations are aimed at during the course of a day. An improvement in the titration tube as illustrated in Fig. 1 was found to be much more convenient for all purposes. When using such a tube the addition of sodium thiosulphate solution is done at a place

slightly away from the point where the stirring operation is carried out. The advantage in

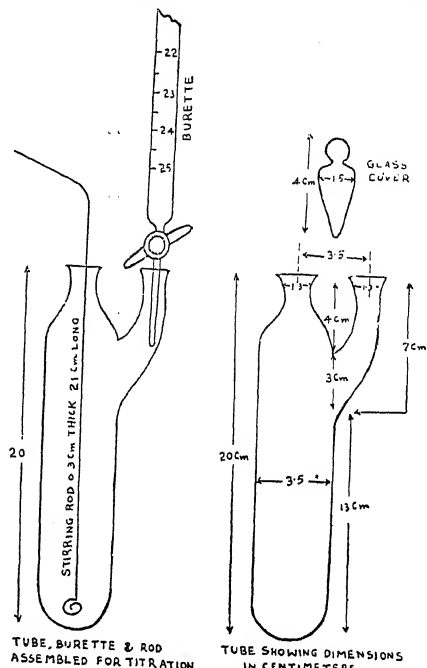


FIG. 1

using this modified tube lies in the operations of stirring and the addition of thiosulphate being carried out simultaneously. Such tubes can be prepared by using readily available material by any glass-blower.

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Preservation,
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Mysore,
January 9, 1959.

S. D'SOUZA.
W. B. DATE.

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ON THE APPLICATION OF FISHER'S "GOODNESS OF FIT" TEST FOR THE HOMOGENEITY OF HEAVY MINERAL ASSEMBLAGES OF THE CAUVERY RIVERSANDS NEAR TALAKAD, MYSORE

THE Cauvery river sands near Talakad, Mysore, extend over an area of 5 sq. miles. The junior author collected fourteen surface samples of these sands on a grid with sampling intervals of 50 yards. In a previous note (1958) he reported on the heavy mineral assemblages of these samples and on a qualitative basis concluded that

the sand body, despite a portion of it being affected by strong winds, shows a fairly uniform heavy mineral assemblage. This proposition viewed statistically resolves itself into the null hypothesis that "Cauvery river sands near Talakad possess a uniform proportion of the different heavy minerals, the observed differences among samples are to be attributed to fluctuations resulting from sampling of a homogeneous population". This hypothesis has now been tested by using Fisher's "Goodness of fit" test as suggested by Eisenhart (1935).

For the purposes of this test two modifications of the published percentage data (Paramasiviah, 1958) were used. (1) Reduction of the number of attributes per sample from 14 to 9 in order to satisfy the requirement of at least five observations of an attribute per cell, (2) the original raw data from which the percentages were computed rather than the percentages themselves (Eisenhart, 1935).

total counts of attributes per sample and in the last row total of an attribute over all samples are also given. From this table the grand chi-square is seen to be 202.35 which exceeds 5% and 1% points for 112 degrees of freedom. This would mean, that such a large or larger chi-square would arise less than one time in every trial of hundred, if the samples had been drawn from a population possessing a uniform proportion of the different heavy minerals. This result leads to the surmise that there are sufficient grounds to believe, as far as the present sampling scheme permits, the Cauvery sands near Talakad are quite heterogeneous in their heavy mineral assemblage. This conclusion seems to run counter to the earlier conclusions of the junior author (1958). However, a careful inspection of Table I reveals that the significant chi-square contributions for the corresponding column totals have come from opaques and amphiboles of samples A1, C2, D1, and from

TABLE I

"Goodness of fit" test for the homogeneity of the heavy mineral assemblages of the surface samples of Cauvery river sands near Talakad

Samples	Opaques	Amphiboles	Chlorite	Garnet	Pyroxene	Kyanite	Tourmaline	Epidote	Rest	Row Chi-square	No of observations per row
A1	.. 34.72*	11.05*	0.50	0.62	3.77	0.05	0.47	0.16	0.00	57.94	S. 264
A2	.. 2.93	0.53	0.20	0.36	0.90	1.14	0.07	0.50	1.45	8.03	N.S. 19
A3	.. 2.27	0.02	1.44	0.08	0.10	1.66	0.07	1.32	0.09	7.05	N.S. 212
A4	.. 0.24	0.60	3.70	3.50	10.12*	0.33	1.33	1.56	1.09	22.48	S. 163
B2	.. 9.45*	0.12	3.06	0.12	0.00	2.59	0.10	2.77	0.59	18.62	S. 135
B3	.. 0.61	0.00	0.70	0.09	1.12	1.89	0.07	1.40	0.35	6.14	N.S. 186
B5	.. 1.52	0.20	0.17	1.45	2.51	2.13	2.57	0.79	0.79	19.93	N.S. 189
C1	.. 0.00	0.02	0.05	0.49	0.12	0.08	0.33	0.27	0.41	1.71	N.S. 161
C2	.. 12.73*	5.00*	0.43	0.40	0.11	0.07	0.79	1.56	1.69	22.69	S. 175
C3	.. 0.08	1.40	0.57	2.57	0.08	2.99	0.23	3.63	0.08	11.59	N.S. 231
C4	.. 1.48	0.51	3.37	1.33	2.50	0.07	0.61	2.72	0.09	12.71	N.S. 197
D1	.. 5.36*	4.70*	0.17	0.08	0.10	0.07	0.00	0.06	0.09	11.63	N.S. 193
D2	.. 0.25	1.60	0.05	0.33	2.50	0.00	3.26	1.32	5.33*	15.34	N.S. 204
D3	.. 0.90	0.20	0.73	0.00	0.40	0.30	0.07	0.53	0.40	3.53	N.S. 184
Column chi-square	72.24	25.95	15.14	11.43	24.32	14.00	9.91	17.85	11.51	202.35	Grand chi-square ..
No. of observations per column	188	671	328	161	135	197	193	251	152	..	2676 Grand sum of observations

* Significant at 5% level for one degree of freedom.

N.S. : Non-significant at 5% level.

S. : Significant at 5% level.

Table I shows the computed chi-square per cell together with row, column and grand totals. For purposes of reference, in the last column,

opaques only in B2, and pyroxenes only from A4. Again, examining the row totals, in case of samples A1, A4, B2, C2 their significance is

mainly due to the fact that significant contributions have come from one or two cells in a corresponding row of nine items. Following Fisher's suggestion (1945, p. 105) if the row total of the chi-squares corresponding to these samples are deleted from the grand chi-square, the latter becomes 87.71 which for 80 degrees of freedom proves non-significant at the 5% level. This may indicate that the total discrepancy between the observed and the expected frequencies based on the present null hypothesis cannot therefore be regarded as quite serious. In addition, it may be also observed that Table I contains a total of 126 cells out of which 9 (indicated by asterisks) have chi-squares significant at 5% level for 1 degree of freedom. The remaining 117 have non-significant chi-squares. This may lead to the suggestion that fluctuations in opaques and amphiboles in three samples and pyroxenes in one, altogether four out of fourteen, have rendered the grand chi-square highly significant. Except for these variations the Cauvery river sands near Talakad, based on the present surface sampling scheme, appear to be homogeneous in their heavy mineral suits.

The writers are thankful to Prof. M. R. Srinivasa Rao for useful discussion and helpful suggestions.

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C. PARAMASIVIAH.

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EFFECTS OF IONISING RADIATION ON SUGARCANE BUDS

ABNORMAL leaves and bifurcations of growing shoots have been observed by several workers¹⁻⁴ in X-rayed scions of pear and apple. Granhall² found that growth was delayed in X-rayed scions. An increase in the colour range of stripes and differences in flowering propensity were reported by Rao³ in plants from X-rayed buds of a striped variety of sugarcane. Tysdal⁶ obtained a partially-striped sugarcane through gamma-irradiation.

Single-budded sugarcane cuttings were exposed to doses of gamma rays ranging from 10 r to 4800 r from a Co₆₀ source and planted in pots, six per treatment, two per pot. In most of the treatments five buds germinated.

One of the germinated buds produced a forked stalk. Partially-dissected leaves were noticed in five of the 69 treated plants of the experiments; however, one such plant was met with among the 18 plants of the control also. In almost all cases, the affected lamina was either the 5th or the 7th from the base. In one treated plant (200 r), the 5th and 7th leaves were fused together along the midrib and along one lateral half of the sheath. In another stalk (200 r), stripes were formed on a few successive internodes and their corresponding leaf-sheaths.

The irradiation affected the growth of the plants also. At four months' age, the irradiated treatments were taller (as measured up to the topmost leaf-tip) than the control, 100 r and 800 r leading. In the first 20 days, the growth was best in the 100 r, 200 r, 400 r and 800 r and was less in the successively higher and lower treatments. In the next 40 days, the lower and medium dosage treatments 10 r to 800 r grew out comparatively faster; between 60 and 120 days, the growth of the higher doses (1200 r, 2400 r and 4800 r) was better. The main differences were reflected in the heights as measured up to the topmost transverse mark from the 50th day onwards.

The table of growth increments suggests broadly that each of the treatments underwent a period of restricted growth and that this occurred at the earliest stage in the higher doses (1200 r to 4800 r) and at a later stage in the successively lower doses. However, a broad difference in growth was noticeable between the treatments 10 r to 800 r on the one hand, and 1200 r to 4800 r on the other. In later experiments, 5 r, 6000 r and 7200 r, made definitely less growth than the controls. In the 14400 r treatment only 3 buds survived, and the growth was only half as much as in the control.

The above effects are probably due to an interference of gamma-radiation with the auxin mechanism of the buds.

Tysdal⁶ has reported that sugarcane buds exposed to gamma rays of 4000 r were either killed or seriously injured. In our experiment the lethal dose was in the region of 14000 r.

The material was irradiated at the Cancer Institute (W.I.A.), Madras. The facilities and assistance so kindly afforded by Dr. S. Krishna-

murti, Scientific Director and Dr. K. S. Chandrasekharan, Chief Physicist, are gratefully acknowledged.

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Sugarcane Breeding Institute,
Coimbatore,
July 10, 1958.

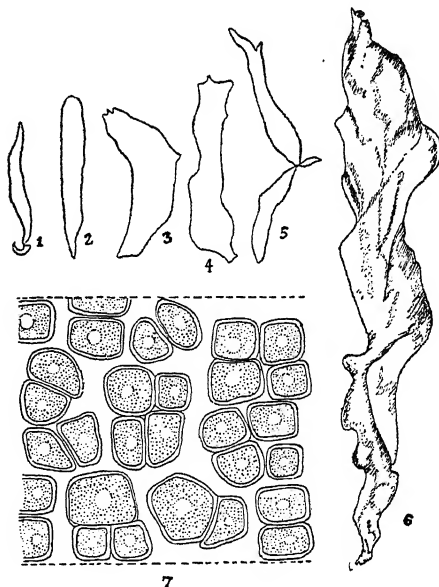
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A NOTE ON THE OCCURRENCE OF *MONOSTROMA QUATERNARIUM* (KUTZ.) DESM. FROM NAINI TAL, INDIA

THE only report about the occurrence of *Monostroma* from India is by Carter,¹ who collected it from the cold snow water of Trisuli River in 1926. The authors collected this alga in September 1956 from a cold water stream situated at a distance of two furlongs down St. Loo barrier on Ratighat Road in Naini Tal. Subsequently the alga was collected in early September this year from a fast flowing stream on the same road near Doonikhal.

This alga was found growing abundantly in small clusters attached to small stones and pebbles. It is short lived (about 2-3 months) and disappears quickly with the drying up of the streams. The thalli are dark-green in colour and are found attached to the substratum by small rhizoidal outgrowths. They are usually in the form of expanded sheets (Figs. 1-6) and measure up to 8 cm. in length 2-2.5 cm. in width. The thalli are found variously crumpled (Fig. 6) perhaps due to the impact of swift water currents. They are usually narrower towards the ends and broader towards the centre. The cells exhibit a parenchymatous structure in surface view (Fig. 7). They are somewhat angular, occurring in groups of 2-4 and are separated from each other by intervening gelatinous material. In cross-section they are somewhat semicircular to oval and measure 11.9-17 μ high. Cells are uninucleate and contain a single parietal laminate chloroplast

(Fig. 7) which encircles the greater part of the cell. Each cell contains a single pyrenoid.



Figs. 1-6. Showing thalli of various shapes and sizes. Note the crumpling of thallus in Fig. 6 (About natural size).

Fig. 7. A portion of the thallus, showing the arrangement of cells in surface view, $\times 1,300$.

The present alga resembles *Monostroma quaternarium*² in the morphology of the frond and vegetative cells, except with slight variations in their average cell measurements.

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Th. D.S.B. Govt. College, K. S. BHARGAVA.
Naini Tal,
October 17, 1958.

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A NEW SPECIES OF *OIDIUM* ON *RAUWOLFIA SERPENTINA*

THE author encountered a large-scale infection of mildew on *Rauwolfia serpentina* Benth. ex Kurz. grown in the green-house of the Morris Arboretum, Philadelphia. It is of considerable interest that even though several species of the genus *Rauwolfia* L., were housed in the same green-house, *R. serpentina* alone was prone to the mildew infection caused by a new species of *Oidium* which has not been so far reported.

This disease is of great economic importance as *R. serpentina* is fast developing into a plantation crop.

The *Oidium* species is described below :

Oidium rauwolfi Varadarajan (spec. nov.)

Mycelium superficial creeping, hyaline, septate and branched, $4.5-6.0\mu$ in diameter forming a mat on the upper surface of affected leaves; haustoria lobed and irregular in shape; conidiophores erect, simple and usually 2-3 septate; conidia unicellular, elliptical, oblong, obtuse and hyaline measuring $25.5-34.5\mu$ in length and $13.5-19.5\mu$ in width and borne singly.

Oidium rauwolfiae Varadarajan (spec. nov)

Mycelium superficiale, reptans, hyalinum, septatum, ramosum, $4.5-6.0\mu$ diameter. efformans tegeticulam in superiore pagina foliorum infectorum; haustoria lobata et irregularia forma; conidiophori erecti, simplices et ut plurimum bis vel ter septati; conidia unicellularia, elliptica, oblonga, obtusa et hyalina, $25.5-34.5\mu$ longa, et $13.5-19.5\mu$ lata singulariter insita.

HABITAT

On the leaves of *Rauwolfia serpentina* Benth. ex. Kurz. grown in the green-house of the Morris Arboretum, Philadelphia. The type was deposited at the Morris Arboretum, Philadelphia, Pa, U.S.A.

THE DISEASE

The mildew was first observed as faint, circular and whitish areas of minutely radiating hyphae on the upper surface of normal leaves of the host. It may be stated here that at the time of the infection, the green-house was overcrowded with plants, the humidity high and the range of temperature between $70-90^{\circ}\text{F}$. All factors, probably, contributed to the rapid spread of the infection.

Sooner, the faint fungal areas on the affected leaves became prominent and several of them coalesced to form a cottony covering over the entire leaf surface. As the severity of the infection increased the diseased leaves started curling upward, rapidly lost the chlorophyll pigment and were finally shed. An examination of the affected leaves revealed that the hyphae of the pathogen have penetrated only the epidermal tissue of the host and the infected cells had disorganised contents, while the entire chlorenchymatous tissue turned yellowish owing to a general disintegration of the chloroplastids.

CONTROL

Affected plants were segregated and severely infected leaves were removed. Weekly dusting of sulphur for 6 weeks brought the disease

under control, while a general dusting of sulphur in the green-house prevented any further spread of the disease.

The author wishes to express his grateful thanks to Prof. Dr. John M. Fogg Jr., Director, The Morris Arboretum, Philadelphia, Pa, U.S.A., for his valuable advice and helpful criticism in the preparation of this paper and to Olin Mathieson Chemical Corp., New York, for the award of a research grant. Thanks are due to Rev. Fr. H. Santapau, St. Xavier's College, Bombay, for Latin diagnosis of the new species described.

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CHROMOSOME NUMBERS IN SOME COMMON FLOWERING PLANTS

The chromosome numbers in the following plants were determined from the study of the pollen mother cells. Anthers from young flower buds were fixed in acetic alcohol solution 3:1 and examined in propiono carmine.

The observations were made from temporary preparations.

TABLE I

Sl. No.	Name of the plant	Family	Number of chromosomes (Haploid number)
1	<i>Acalypha indica</i> L.	Euphorbiaceae	14
2	<i>Asperagus racemosus</i> Willd.	Liliaceae	30
3	<i>Hibiscus rosasinensis</i> L.	Malvaceae	18
4	<i>Ipomaea testigridis</i> L	Convolvulaceae	15
5	<i>Ipomaea pentaphylla</i> Jacq.	do.	15
6	<i>Mucuna monosperma</i> DC.	Papilionaceae	11
7	<i>Parthenium hysterphorus</i> L.	Compositae	18
8	<i>Punica granatum</i> L. ..	Punicaceae	8
9	<i>Rhynchosia auria</i> L. ..	Papilionaceae	11
10	<i>Rhynchosia humilis</i> Benth.	do.	11

The chromosome number of *P. granatum* is $n = 8$ (Tjio, 1948), $2n = 18$. 19 (Kostaff *et al.*, 1935) and $n = 9$ (Proos, 1938) (as given by Darlington and Wylie, 1955). The chromosome number in common pomegranate grown around Poona has been found to be $n = 8$.

The chromosome number in red, single corolla type shoe flower (*H. rosasinensis*) was observed to be $n = 18$. This number appears to be very low when compared with the previous records by Skovested (1935) as $n = 92$, Youngman (1927) as $n = 144$ and Skovested (1941) as $n = 168$.

To the best of the knowledge of the author, the chromosome numbers reported herein, except that of *P. granatum*, are new records.

Cytology Laboratory,
Botany Section,
College of Agriculture,
Poona-5,
October 27, 1958.

M. V. THOMBRE.

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REDUCTION IN THE INTENSITY OF CHLOROSIS ON MANDARIN PLANTS (*CITRUS RETICULATA* SWINGLE)

SYMPTOMS of zinc deficiency in citrus trees have been described by Batchelor and Webber (1948), Camp, Chapman and Parker (1949), Smith and Reuther (1954) and Dikshit (1958 a). Symptoms of chlorosis and drying of young shoots on seedling mandarin plants have been reported by Dikshit (1958 b). He also has reported reduction in the intensity of chlorosis on two-year old citrus plants following sprays with zinc sulphate. Mukherjee (1949) has reported deficiency of zinc and manganese from soils in Coorg. The present note embodies the results of sprays with proprietary fungicides containing diethyldithiocarbamates of zinc and iron on ten-year old seedling mandarin trees. These compounds (Triscabol and Trifungol) have been tried with good results by Teitsma and Hadi-vidjaja in Indonesia.

Ten-year old severely affected plants, which were comparable in vigour, were selected for the study. Five plants were sprayed with Triscabol + Trifungol (34 gm. + 17 gm. per four

gallons of water), the plants receiving six sprays from July to December 1957, at monthly intervals. Another set of five trees was treated as control and did not receive the sprays. All the ten trees received identical fertiliser treatments, viz., one pound of nitrogen as ammonium sulphate, half pound of phosphorous as superphosphate and half pound of potash as muriate of potash. Intensity of chlorosis was determined by classifying the trees in 0, 1, 2 and 3 grades depending upon the increasing severity of the symptoms, healthy plants being put in grade 0 and the maximum affected ones in grade 3. Separate scoring was done in respect of the younger leaves which were situated towards the periphery and the older ones which were located towards the main stem. A plant which had most of the new and old shoots showing chlorosis thus scored 6 marks. This was considered to be equivalent to 100% intensity on the plant. The observations were continued for a period of 12 months, 6 months during which the sprays were being given and another six months after the sprays were discontinued. Thus a fairly representative picture of the response could be obtained by the figures available. Percentages of intensity of chlorosis per plant from August 1957 to July 1958 are given in Table I.

Figures given in Table I indicate a reduction in the intensity of chlorosis on the sprayed plants. The present finding with ten-year old plants confirms the trends reported earlier with two-year old seedlings. In a number of observational spray trials, conducted on ten-year old plants, with zinc, manganese, iron and copper, consistent positive response was obtained with zinc sprays only. In none of the cases, however, could complete recovery be effected. The incomplete recovery of the plants may be due to co-existent deficiency of some other micro or macro-element along with that of zinc.

Well-marked periodic variations in the intensity of chlorosis during different months irrespective of the spray treatment are another

TABLE I

Showing intensity of chlorosis per plant on sprayed and unsprayed plants during different months

Treatment	1957					1958							Mean
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	
Sprayed	66.0	26.0	40.0	33.0	26.0	20.0	23.0	23.0	0.0	30.0	36.6	26.6	29.2
Unsprayed	100.0	53.3	53.3	80.0	76.7	73.0	60.0	70.0	10.0	56.0	80.0	63.3	64.6

interesting feature of this study. In the present instance intensity of chlorosis came down to 26% per tree on the sprayed plants in the third month after the commencement of observations. A similar reduction was observed on the unsprayed plants also but they had comparatively higher intensity (53%) during the corresponding month. Again the intensity on sprayed plants fluctuated between 20 and 40% while on the unsprayed plants it was 53 and 80%. Total absence of symptoms on the sprayed plants during the month of April, and a very well-marked reduction in intensity on unsprayed plants during that month are features which are being investigated further.

I thank Dr. R. D. Asana for kindly suggesting this line of approach and giving the chemicals for trial, and Dr. K. M. Aiyappa for his interest in the work. Warm thanks are also due to Sri. M. C. Mathew and Sri. M. Abraham, Manager and Superintendent respectively, who permitted this observational trial at their Huvinkadu Estate, and provided facilities for spraying and other field operations.

Plant Physiologist, N. N. DIKSHIT.
Citrus Die-back Scheme,
P.O. Gonikoppal, Coorg,
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BLUE MOLD OF AMLA (*PHYLLANTHUS EMBLICA* L.)*

It was found that Amla fruits, in storage rooms and market places in Banaras, were affected by a species of *Penicillium*, which so far as the author is aware, has not been described before.

The rot is characterized by brown patches with water-soaked areas surrounding a wound which soon increases in size assuming a light brown colour and becomes quite soft and sunken. As the rot progresses, three distinct colour zones of

bright yellow, purple brown followed by a bluish green conidial mass from the centre of the rotten portion spreading gradually to the whole fruit can be clearly observed with the exudation of drops of yellowish liquid on the fruit with a bad odour. The whole fruit finally gives a bluish green pustuled or beaded appearance.

A microscopic examination of the rotted portion showed fungal hyphae from which arise, funiculate hyphae bearing conidiophores (50-75 μ) which produce a terminal symmetrical verticil of usually several metulae 4-6 in number (8-10 \times 2-2.8 μ) bearing symmetrical verticil of sterigmata. Sterigmata are shorter and parallel, closely packed in clusters, 5-8 in number (7-9 \times 1.8-2.2 μ). Conidia are elliptical to globose (3-3.5 \times 2.5-3 μ), smooth and borne in short chains. A symmetrically biverticillate penicillus is the characteristic feature of the organism and it is identified as *Penicillium islandicum* Sopp. (Raper and Thom, 1949).

The following control measures have been found to be useful in arresting the fruit rot: (a) careful handling of the fruits to avoid injuries through which natural infection takes place, (b) securing sanitary conditions in the storage rooms by gas treatment of NCl_3 and Ozone with good ventilation and (c) treatment of fruits with mild antiseptics like borax and sodium chloride in very dilute concentrations.

My thanks are due to Prof. A. Lal, College of Agriculture, Banaras Hindu University, for guidance and interest in the course of the present work.

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Osmania University,
Hyderabad-7,
December 10, 1958.

* Part of the thesis submitted for M.Sc. (Ag.), at Banaras Hindu University, Banaras.

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INHERITANCE OF FOURTH GLUME IN CERTAIN *SACCHARUM* HYBRIDS

SEGREGATIONS in sugarcane crosses are not easy to explain on account of the cytogenetical complexities of the plant as also the mode of gamete and zygote formation in the parents. There is a wide range of variation in the F_1 seedlings of any cross or even in the selfed progeny of any single variety.

The present note relates to a finding made with regard to the inheritance of the Fourth Glume in the intergeneric crosses between the two species

TABLE I
Showing the number of seedlings examined in different crosses

Sl. No.	Cross			No. of seedlings studied
1	<i>S. officinarum</i> var. Vellai	(2n=80)	×	<i>Sclerostachya fusca</i> (2n=30) 13
2	do. Lakhapur	(2n=80)	×	do. do. 7
3	do. Zw. Cheribon	(2n=80)	×	do. do. 3
4	do. K. Boothan	(2n=80)	×	do. do. 4
5	do. Chittan	(2n=80)	×	do. do. 14
6	do. Manjri Red	(2n=80)	×	do. do. 62
7	do. Kajla	(2n=68)	×	do. do. 112
8	do. Vellai	(2n=80)	×	<i>Narenga</i> do. 2
9	do. Zw. Cheribon	(2n=80)	×	do. do. 1
10	do. K. Boothan	(2n=80)	×	do. do. 1
11	do. Chittan	(2n=80)	×	do. do. 3
12	do. Kajla	(2n=68)	×	do. do. 65
13	<i>S. robustum</i> S.H. 598 (28 N.G. 251)	(2n=84)	×	<i>Sclerostachya</i> do. 66
14	<i>Sclerostachya fusca</i>	(2n=30)	×	<i>S. robustum</i> S.H. 598 (28 N.G. 251) (2n=84) 6
15	<i>S. robustum</i> S.H. 598 (28 N.G. 251)	(2n=84)	×	<i>Narenga</i> (2n=30) 22
16	<i>S. officinarum</i> var. Manjri Red	(2n=80)	×	<i>Erianthus ciliates</i> (2n=40) 14

of *Saccharum*, viz., *S. officinarum* and *S. robustum* on the one hand and the allied genera, viz., *Narenga*, *Sclerostachya* and *Erianthus* on the other. Most of the varieties belonging to the two species mentioned above are characterised by the absence of the Fourth Glume, as distinct from other species of *Saccharum*, viz., *S. barberi*, *S. sinense* and *S. spontaneum* and also the allied genera, *Narenga*, *Sclerostachya* and *Erianthus* in which the Fourth Glume is always present. Seedlings from a large number of crosses were examined for this character as detailed in Table I.

A study of the Floral Morphology of the F_1 populations listed in Table I showed the presence of the Fourth Glume in all the crosses. It may be mentioned that the Fourth Glume is also similarly transmitted in the interspecific cross between *S. officinarum* and *S. spontaneum*. The presence of the Fourth Glume in the F_1 seedlings in all the above-mentioned crosses indicates that it is dominant in inheritance and offers a valuable criterion for determining the genuineness or otherwise of certain *Saccharum* crosses.

The authors take this opportunity to express their deep sense of gratitude to Dr. N. R. Bhat, Director, Sugarcane Breeding Institute, Coimbatore, for valuable suggestions and keen interest.

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K. S. SUBBA RAO.

Sugarcane Breeding Institute,
Coimbatore,
December 13, 1958.

PUCCINIA ERIANTHI, PADW. AND KHAN ON CULTIVATED SUGARCANE

Rust on *Saccharum*, *Puccinia kuehnii* (Kr.) Butl. has been recorded on *S. spontaneum* by Butler.² Only two species, namely, *P. kuehnii* (Kr.) Butl. and *P. erianthi*, Padw. and Khan,⁶ were known to occur in India. Patel *et al.*⁷ observed this disease on a cultivated variety Co. 475 in Bombay State and identified it as a new species, *P. sacchari*. Chona and Munjal,⁴ however, identified the rust on Co. 475 obtained from the same area as *P. kuehnii* (Kr.) Butl. The rust found on the cultivated variety, viz., Co. 876 was also reported as *P. kuehnii* (Kr.) Butl. by Chenulu³ and Srinivasan⁸ respectively.

During November 1958, rust was collected on two sugarcane varieties, namely, Co. 1191 and Co. 1243 from the varietal collections at the East India Distilleries and Sugar Factories, Nellikuppam and from Co. 1243 at the Sugarcane Research Station, Cuddalore.

The rust on Co. 1191 occurs on the leaves only. The most important features of the urediospores are as follows:—uredia hypophyllous, sometimes amphigenous, sub-epidermal, urediospores ovoid to pear-shaped, thick-walled, uniformly thickened all round, rarely slightly more thickened at the apex, echinulate, with 3-4 large distinct pores (Fig. 1), generally 4, either equatorial or scattered, measuring $20.85-39.62\mu$ ($27.11-33.36\mu$) in length by $16.68-27.11\mu$ ($18.77-25.02\mu$) in width, paraphyses in uredia capitate, on long stalks, thick-walled, pale to brick colour.

Telia occur on the undersurface of the leaf, sometimes on the upper surface also, sub-epidermal, teleutospores (Fig. 2) two-celled, smooth-walled, not uniformly thick, always more

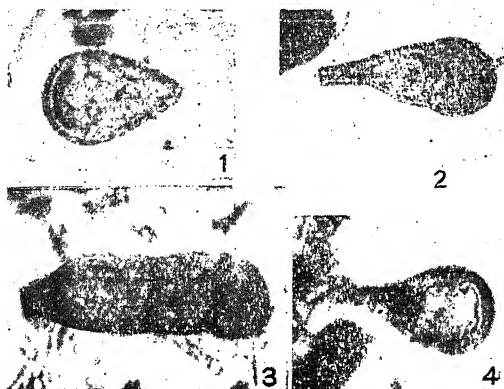


FIG. 1. The urediospore with 4 distinct germ pores. FIG. 2. The normal two-celled teleutospore. FIG. 3. The abnormal 3-celled teleutospore. FIG. 4. The abnormal 1 celled teleutospore.

16.68-29.19 μ (18.77-22.94 μ) in width and the teleutospores 33.36-52.13 μ (37.53-50.04 μ) in length by 16.68-25.02 μ (18.77-22.94 μ) in width, almost the same size as that found on Co. 1191. In other characters, this rust resembles that on Co. 1191. The abnormal 3-celled and 1-celled teleutospores were observed in this case also.

The rust on Co. 1191 and Co. 1243 differs from the one on *S. spontaneum*, *P. kuehni* (Kr.) Butl. described by Butler² and Srinivasan and Chenulu⁸ in a number of important characters as mentioned in Table I.

The rust observed on Co. 1191 and Co. 1243 has a close resemblance to *P. erianthi*, Padw. and Khan and hence is identified as such. Further studies are in progress.

We are highly grateful to Dr. N. R. Bhat, Ph.D. (Cantab.), Director, Sugarcane Breeding Institute, Coimbatore, for his keen interest and encouragement. Our thanks are also due to Dr. K. Ramakrishnan, Government Mycologist, Agricultural College, Coimbatore, for his valuable suggestions.

TABLE I

Sl No.	Characters	Rust on Co. 1191 and Co. 1243	Rust on <i>S. spontaneum</i> <i>P. kuehni</i> (Kr.) Butl.	<i>P. erianthi</i> , Padw. & Khan
1	Size of urediospores ..	27.11-33.56 \times 18.77-22.94 μ	19.57 \times 18.74.5 μ	24.1-34.9 \times 18.1-25.3 μ
2	Apical thickening of the urediospores	Almost uniformly thick all round, rarely slightly thickened at the apex	Protruded apical thickening	Slightly thickened at the apex
3	Germ pores ..	3 or 4, usually 4 distinct pores, either equatorial or scattered	3-5, equatorial	4, large distinct pores, equatorial or scattered
4	Occurrence of teleutospores	Occur abundantly	Generally absent, if present scanty and immature	Present
5	Size of teleutospores ..	37.53-50.04 \times 18.77-25.02 μ	25.40 \times 10-18 μ	28.9-45.8 \times 14.5-21.7 μ
6	Colour of the spores ..	Pale to brick colour or Kaiser brown (Kidway)	Yellow	Pale to brick colour

thickened at the apex, clavate, the apical cell usually rounded, the lower one elongated, slightly broad above and narrowed below with a slight constriction at the septum, the length of the stalk ranging from 6.24-25.02 μ (usually 10.4-12.5 μ). The teleutospores occur in large numbers ranging from 33.36-52.13 μ (37.53-50.04 μ) in length by 16.68-29.19 μ (18.77-25.02 μ) in width.

In this sample, certain abnormalities of teleutospores were observed. Some spores were distorted in shape. Three-celled (Fig. 3) and one-celled (Fig. 4) teleutospores were rarely met with. Such aberrations are not uncommon in the species of *Puccinia* and it was thought as a teratological feature by earlier workers.^{1,5}

The urediospores of the rust on Co. 1243 collected at Nellikuppam and Cuddalore measure 20.85-39.62 μ (27.11-33.36 μ) in length by

P. A. KANDASAMI.
U. VIJAYALAKSHMI.

Sugarcane Breeding Institute,
Post Lawley Road,
Coimbatore,
December 20, 1958.

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ROOT AND NODULE DEVELOPMENT IN *DOLICHOS LABLAB* L. INFECTED WITH *DOLICHOS ENATION MOSAIC* VIRUS

DOLICHOS enation mosaic virus, first reported in India by Capoor and Varma,¹ infects a large number of leguminous plants producing characteristic enations besides mottling and laminar suppression. In an attempt to study the effect of the virus infection on the subterranean parts of *Dolichos lablab* L., it was found that in fully infected plants the root system was poorly developed and the number of root nodules surprisingly reduced (Fig. 1).



FIG. 1. Effect of *Dolichos* enation mosaic virus on the root system of *Dolichos lablab*.

1 and 2—Control.

3 and 4—Infected (note the suppression of root nodules).

The intensity of these symptoms appears to be directly related to the severity of infection.

Seeds of *Dolichos lablab* (variety DL 231) obtained from the Agricultural College, Coimbatore, were sown in garden soil in large clay pots and when the first pair of the foliage appeared, they were inoculated with a standard extract of inoculum of *Dolichos* enation mosaic virus (1 g. of young infected leaves of *Dolichos lablab* ground in 1 ml. of glass-distilled water) using 500-mesh carborundum powder as an abrasive. One set of uninoculated plants served

as the control. After about a month of inoculation the healthy and infected plants were carefully lifted out without damaging the root system for examination.

Bakshi and Singh² have reported a reduction of root nodules in shisham (*Dalbergia sissoo* Roxb.) infected with *Fusarium solani*. Similarly, *Cajanus cajan* infected with *Fusarium udum* has been shown in this laboratory to contain poorly developed nodules (Subramanian, unpublished). The poor development of the root system may be attributed to a low auxin content of the roots as reported in the case of 'potato degeneration' diseases.^{3,4} It, however, remains an open question whether the reduction in root nodules is due to deranged metabolism of the infected host resulting in the formation of inhibitors/products not conducive to the formation of the nodules. The direct action of the virus on the nodule organism and the modified morphology of the root tissues⁵ preventing the hypertrophy for formation of the nodule, can also be hardly ruled out. Further studies are under way.

The author is indebted to Prof. T. S. Sadasivan, Director, University Botany Laboratory, Madras, for encouragement and suggestions.

University Botany Laboratory, V. T. JOHN.
Madras-5, January 14, 1959.

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TUBERCULINA—HYPERPARASITE OF *AECIDIUM AMARYLLIDIS* SYD. AND BUTLER

Aecidium amaryllidis Syd. & Butler has been found to occur for the last two years during the rainy season (August, September) on the leaves of *Crinum asiaticum* growing in the Public Gardens and Karkhana Bag, Kota. In the month of September 1958, the æcia were found covered with a whitish grey fungal coating. In the transverse sections, the hyperparasite in the æcia showed purple colour with smooth sporodochia. Aeciospores and basal cells were found in a process of disintegration. In later stages, the disintegration of the æcial plectenchyma has been followed by the development of sporodochia. In cases of the attacked developing æcium, the development of aeciospores does not take place

and the æcium is completely occupied by the hyperparasite. The conidiophores are simple, non-septate, hyaline and bear single-celled, hyaline, spherical, smooth, thin-walled, single conidia aconogenously. The spores measures 7.2 to 9.0 μ .

The uridiniculous nature of the fungus with smooth sporodochia, hyaline mycelium and conidia confirm it to belong to the genus *Tuberculina* Sacc. To the best of the knowledge of the authors the hyperparasite has not been recorded so far, on *Aecidium amaryllidis* Syd. & Butler. *T. persicina* (Ditm.) Sacc. has been found to occur on æcidia of *Aecidium euphorbiae*,¹ *Puccinia arrhenatheri* and *Aecidium rhamni*⁴ and *T. vinosa* on those of *P. poarum*.¹

In India, two species of *Tuberculina*—*T. costaricana* Syd. parasitizing æcia and pycnia of *Uromyces hobsoni* Vize.³ and *T. persicina* on the æcia of *Aecidium pavettæ* Berk. and *Aecidium* sp. on *Strobilanthes cuspidatum* T. And²—have been reported.

On the basis of the morphological characters of the fungus, the shape and the size of the conidia, it is identified to be *T. costaricana* Syd. It is the first record of the hyperparasite on this host.

Sincere thanks are due to Dr. N. Prasad, Plant Pathologist, Rajasthan, for keen interest and encouragement and to Shri Samarth Raj, Director of Agriculture, Rajasthan, for facilities.

Plant Pathology Section, R. L. MATHUR.
Dept. of Agriculture, J. P. AGNIHOTRI.
Rajasthan, Udaipur,
November 24, 1958.

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* Not seen in original.

OCCURRENCE OF A MICROSPORIDIAN (PROTOZOA) PARASITE IN FRESH-WATER OLIGOCHAETES

WHILE studying the freshwater oligochaetes *Pristina longiseta longiseta* and *Nais communis*, belonging to the family Naididae, from the vicinity of Cuddapah, Andhra Pradesh, South India, sporocysts of the microsporidian *Mrazekia caudata* Leger and Hesse, 1916, were found in the coelom of the middle region of four worms. This parasite was hitherto known only from the members of the family Tubificidae. Different

stages of development of the sporocysts were observed: small colourless cysts without spores, medium cysts of translucent, greenish gray colour with minute unripe spores, and large, opaque, dark gray cysts containing hundreds of closely packed ripe spores. The ripe spores are liberated by rupture of the sporocyst wall into the host coelom, where they escape by death and disintegration of the host or probably by way of nephridia. The presence of several sporocysts in one worm proves fatal. The ripe spore (Fig. 1) measures 23-27 μ in length and 1.5 μ in width, hence is longer than the original description. It has a cylindrical body containing a nucleus and a pointed caudal end.

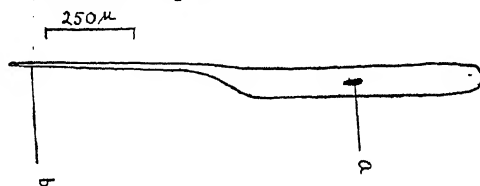


FIG. 1. *Mrazekia caudata*: ripe spore. a, nucleus; b, caudal end.

This is the first finding of the microsporidian parasite in Asia.

I thank Dr. L. H. Hyman of the American Museum of Natural History, New York, for her help in the preparation of this note.

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December 12, 1958.

AN INEXPENSIVE TAG FOR MARKING HILSA

ONE of the major difficulties encountered in undertaking large-scale marking experiments to study the migrations and population dynamics of fishes in India has been the non-availability of suitable tags locally at reasonable cost. Efforts were therefore made to hand-fabricate inexpensive tags in this Research Station. A type of nylon streamer tag thus developed and found quite suitable for marking Hilsa is described here. The cost of the tag works out to less than a rupee per hundred.

The tag (Fig. 1) consists of a rectangular strip of yellow or red soft upholsterer's vinyl plastic, 35 mm. \times 12 mm. and about 0.2 mm. thick. One end of the plastic strip is rounded and a hole is punched at the other. The necessary legend and serial number are written on either side of the tag with an artist's pen, or are stamped on with rubber stamps. This is done with Vinyl

Stamping Black Ink 104N5A4 manufactured by the California Ink Company, U.S.A. Before writing the legend the tag is cleaned with a piece of cloth soaked in acetone in order to remove the glaze and any extraneous matter that might prevent the ink biting into the

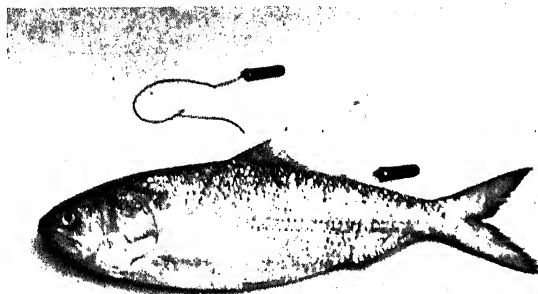


FIG. 1. Photograph of a tagged Hilsa. A tag with the needle is shown above it.

plastic. About 35 cm. of braided nylon thread is doubled and the free ends are drawn through the punched hole and tied over the rolled-up end of the plastic strip to prevent its tearing off when pulled. First a box knot is tied and this is reinforced by a reef knot. The two free ends of the thread are then sealed together by holding them over a candle flame with a pair of small pointed forceps. The necessity for rolling the end of the tag can be avoided if a light plastic eyelet is fixed in the punched hole. Another guard knot may be tied on the nylon streamer about 25 mm. above the tag to prevent the knot from slipping when the tag is finally tied to the fish.

For marking Hilsa, the tag is tied on the dorsal side of the fish. Immediately after capture the live fish is placed in a specially constructed "cradle" lined with plastic foam sheeting, which is kept immersed in water. The nylon thread is passed through the dorsal musculature of the fish immediately behind the dorsal fin (Fig. 1) with the help of a surgeon's needle, about 7 cm. long, having a bent end. A knot is then tied below the guard knot on the length of the streamer, which will prevent the loop from tightening itself on the body of the fish. During the last Hilsa fishing season over 750 Hilsa were tagged with this type of tag and the recovery so far is about 8%. The recovered fish were all in good condition and the tags were easily recognised by the fishermen. The size of the tag allows fairly explanatory legend which can

be written in any language as required and this helps the recovery considerably. The longest period of submersion observed by us so far is nine months and the tag had hardly any effect on the tag.

Central Inland Fisheries T. V. R. Pillay
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Calcutta-9,
January 9, 1959.

A NOTE ON THE CHEMICAL EXAMINATION OF THE CONSTITUENTS OF THE BARK OF *FERONIA ELEPHANTUM*

From the alcoholic extract of the bark of *Feronia elephantum* (natural order Rutaceae), two compounds having the molecular formulae $C_{29}H_{40}O_9$ and $C_{29}H_{41}O_9$ have been isolated in the pure form. The compound $C_{29}H_{40}O_9$ melts at $176-77^\circ C.$, is soluble in ethanol, methanol and pyridine but insoluble in water, petroleum ether, ether, benzene, chloroform and ethyl acetate. It does not react with sodium bicarbonate but dissolves in sodium hydroxide solution producing a deep yellow coloured solution from which the original compound can be precipitated back by the addition of mineral acids. The compound gives a dirty green colour with ethanolic ferric chloride and forms an acetyl derivative and a benzoyl derivative. The molecular weight of the compound could not be determined by the cryoscopic or the ebullioscopic method because of its insolubility in suitable solvents, nor could it be determined by the Rast method because of its immiscibility with camphor. The molecular weight of the benzoyl derivative was, however, determined by the Rast method and from the results of the elementary analysis, and molecular weight of the benzoyl derivative, the molecular weight of the original compound was computed. As a result of these the compound has been found to contain six hydroxyl groups. The presence of one methoxyl group in the compound has been established by the Ziesel's method. The compound formed a 2:4 dinitro-phenylhydrazone which was found to contain 7.56% of nitrogen, corresponding to the presence of one ketonic group.

As a result of the study of the I.R. absorption spectra of the compound, the presence of the following groups is indicated: an unconjugated $C=O$ group (peak at 5.832μ), a $C=C$ unconjugated unsaturation (peak at 6.065μ), phenyl ring (peaks at 6.121 and 6.650μ), a

methyl ketone (peak at 6.854 $m\mu$), a C-methyl group (peak at 7.272 $m\mu$), a methoxyl group (peak at 7.519 $m\mu$), Ar-O-CH₃ group (peak at

7.968 $m\mu$), a $\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ | \quad | \\ -\text{CH}-\text{CH}- \end{array}$ linkage (peaks at 8.906

and 9.091 $m\mu$) and a 1:3:5-trisubstituted benzene ring (peak at 12.15 $m\mu$). The detailed study of the structure of this compound and its degradation products is in progress.

Chemical Laboratories,
Allahabad University,
Allahabad,
January 13, 1959.

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TOLBUTAMIDE AND PANCREATIC ACTIVITY OF GUINEA-PIGS

"TOLBUTAMIDE" (1-butyl-3-*p*-tolysulphonylurea) has now been well established as a suitable orally effective hypoglycemic agent for diabetic patients with the "maturity onset" type of diabetes mellitus.¹ In spite of various investigations by different workers, the precise mechanism of action of such sulphonylureas remains unknown.

Holt, Kracht and others have demonstrated²⁻⁴ increased β -cell activity in normal animals on administration of "Tolbutamide". Campbell's⁵ experiments suggest a sparing action of Tolbutamide on the insulin secreting mechanism. Definite information is not yet available on the direct or indirect effects of Tolbutamide on the histological changes brought about in the α , β and the acinar cells, on prolonged administration of the drug to normal animals. Preliminary results obtained in one of a series of experiments on the pancreatic activity of guinea-pigs in response to prolonged daily administration (oral) of Tolbutamide are indicated in the present communication.

Groups of normal healthy guinea-pigs were administered 'Tolbutamide' powder⁶ orally, in a daily dose of 100 mg./kg. The pancreatic amylase content of these animals and the biological potency of their pancreatic insulin were determined at regular intervals by using standard methods.^{7,8} The results are given in Table I.

The animals getting Tolbutamide showed no signs of any toxicity and maintained excellent health. The overall increase in body weight

TABLE I
Effect of Tolbutamide Feeding on the Amylase and insulin content of the pancreases of guinea-pigs (Average figures)

Groups	No. of animals	Days of Tolbutamide feeding	Pancreatic amylase (mg. of maltose gm. of dry pancreas)	Pancreatic insulin potency by rabbit assay method (% reduction/gm. of pancreas)
I	4	0 (control)	654.10	14.72
II	4	43	1688.00	15.53
III	4	59	1756.00	..
IV	4	64	2672.00	42.14

in sixty days in the Tolbutamide fed group was found to be 17.28% higher than their litter mates in the control group.

It is evident from Table I that both insulin potency as well as pancreatic amylolytic activity increases gradually with prolonged feeding of Tolbutamide in guinea-pigs. The increase in insulin potency may be interpreted to be due to an increased secretory activity of the β -cells or a suppression of activity of the α -cells or both; whereas the significant simultaneous increase of the amylolytic activity/gm. of tissue may be due to an increased proteosynthetic activity of the acinar cells.

Biochemistry Laboratory, H. D. BRAHMACHARI.
Birla College, Pilani, MAHENDRA KUMAR.
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REVIEWS

DOVER BOOKS

Statics and Dynamics of a Particle. By William Duncan MacMillan. Pp. xviii + 430. Price \$ 2.00.

Theoretical Mechanics, An Introduction to Mathematical Physics. By Joseph Sweetman Ames and Francis D. Murnaghan. Pp. ix + 462. Price \$ 2.00.

The Fundamental Principles of Quantum Mechanics with Elementary Applications. By Edwin C. Kemble. Pp. xvi + 611. Price \$ 2.95.

Selected Papers on Quantum Electrodynamics. Edited by Julian Schwinger. Pp. xvii + 424. Price \$ 2.45.

The Theory of the Potential. By William Duncan MacMillan. Pp. vi + 469. Price \$ 2.25.

Vector Analysis with an Introduction to Tensor Analysis. By A. P. Wills. Pp. xxxii + 276. Price \$ 1.75.

An Introduction to Fourier Methods and the Laplace Transformation. By Philip Franklin. Pp. x + 289. Price \$ 1.75.

Introduction to Bessel Functions. By Frank Bowman. Pp. 134. Price \$ 1.35.

The Foundations of Euclidean Geometry. By Henry George Forder. Pp. xii + 349. Price \$ 2.00.

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An Introduction to the Geometry of n-Dimensions. By D. M. Y. Sommerville. Pp. xvii + 196. Price \$ 1.50.

Lectures on the Theory of Elliptic Functions. By Harris Hancock. Pp. xxiii + 498. Price \$ 2.55.

Elliptic Integrals. By Harris Hancock. Pp. viii + 101. Price \$ 1.25.

The Dover Publications, Inc., has been rendering valuable service to the scientific community of the world by reprinting standard textbooks and classics in science, and bringing them out as cheap editions that are within the reach of any research worker of moderate means. A glance at the list of publications of the Dover series will impress one that the selection of these books has been inspired by the highest principles of scientific standard, and several of the books of the series, if not all, have been reigning for over a few decades as the undisputed classics in their respective subjects. The

books on Mathematics and Theoretical Physics of which the present review is concerned, have special value to research students, since research under modern conditions demands a basic stock of mathematical knowledge and the Dover books supply just this need.

Statics and Dynamics of a Particle by William Duncan MacMillan is an elementary text-book on the subject, which covers approximately the syllabus of the B.Sc. Degree Course of the Indian Universities. Written in a clear style, the book is illustrated through the solution of a number of basic problems in astronomy, ballistics, transmission of power, elasticity and related topics.

Theoretical Mechanics, An Introduction to Mathematical Physics by J. S. Ames and F. D. Murnaghan provides a sound basic knowledge of the principles of mechanics that is necessary for a research worker in physics, theoretical or experimental. Starting from Newton's laws, the book leads the reader soon to advanced topics and gives an excellent account of general dynamical systems, Lagrange's and Hamilton's equations, the principle of least action, holonomic and non-holonomic systems, small vibrations, wave motion and Lorentz transformation.

Among the numerous books that have appeared on Quantum Mechanics, *The Fundamental Principles of Quantum Mechanics with Elementary Applications* by Kemble occupies a respected place and has been popular ever since it was published. A special aspect of this book seems to be the detailed discussion of the theory of eigenfunction expansion and orthogonal functions, and the elaborate treatment of the operator formalism of Quantum Mechanics. Containing a wealth of information both on the mathematical formation of Quantum Mechanics and the problems of atomic structure, the book will be of great value to every student of physics who desires to get a thorough understanding of Quantum Mechanics.

Of all the books of the series, the volume *Quantum Electrodynamics* by Julian Schwinger is perhaps the only one that deals with topics of current interest. Edited by one of the foremost figures in the field, the volume contains every paper that made its strong impact on the subject and has contributed to its development in its present form. The papers cover almost all aspects of Quantum Electrodynamics, and

the volume therefore serves even the purpose of a text-book while it has the additional advantage of unfolding the subject through its own creators, each with his characteristic individual style. This volume represents the struggle of the human mind to penetrate into the depths of Nature, the height to which mathematical imagination and ingenuity can fly, and yet tragically enough, the elusiveness of Nature to all such attempts.

The theory of the potential knows no limit for expansion and has enriched several branches of pure mathematics while lending its usefulness and application to such fields as applied mechanics. The republication of MacMillan's electrostatics, magnetostatics and quantum mechanics. The republication of MacMillan's long unavailable *Theory of Potential* will therefore meet the current need for an extensive text on the subject and will be welcomed by mathematicians, pure or applied, physicists and engineers. CONTENTS: Attraction of finite bodies, The Newtonian Potential function, Vector fields, Surface distribution of matter, Spherical harmonics and Ellipsoidal harmonics.

Vector Analysis with an Introduction to Tensor Analysis by A. P. Wills is a clear and comprehensive exposition of vector and tensor analysis and can be recommended as a text to all physicists and engineers unacquainted with this subject. Dr. Franklin's *Introduction to Fourier Methods and the Laplace Transformation* has been designed to introduce engineers, physicists, applied mathematicians, students and teachers of physical sciences, to the theory and application of Fourier series and Laplace transforms. CHAPTER HEADINGS: Complex quantities, Fourier series and integrals, Partial differential equations, Boundary value problems and Laplace transforms.

Introduction to Bessel Functions by Frank Bowman: As the title indicates, the book gives an introduction to the subject of Bessel functions.

The Foundations of Euclidean Geometry by Henry George Forder gives a connected and rigorous account of Euclidean geometry in the light of modern investigations. Although the propositions of Euclidean geometry are assumed to follow consistently from their axioms, critical examination has disclosed many vaguenesses and unproved assumptions in the Euclidean formulation. Further these researches have led to the discovery of non-Euclidean geometries, thus freeing the mind from its age-long bondage to the obvious and leading it to the newer

conceptions of space that is common knowledge today. The book under review derives the Euclidean propositions from the axioms employing the mathematical discoveries of modern times and making the smallest number of assumptions possible. The book must be read by every teacher of geometry in schools and colleges.

Sommerville's *The Elements of Non-Euclidean Geometry* is a popular book on the subject and has been a standard text in the field. It can be read with delight by anyone with a good knowledge of high school algebra and geometry. The author outlines here lucidly the historical development of non-Euclidean geometries, the Playfair axiom and the consequences of its breakdown, elliptic and hyperbolic geometries and a few other topics like inversion and transformations. *An Introduction to the Geometry of n-Dimensions* by the same author was unavailable for many years and is perhaps the only book in English devoted to the subject of higher dimensional geometry. The author demonstrates in this book several representative topics of n -dimensional geometry which not only illustrate the extensions of three-dimensional geometry but reveal results which are unexpected and where analogy would be a faithless guide. The book treats the analytical geometry of n -dimensions both from the projective and metric points of views, and in addition contains several chapters on polytopes.

The reissue of Hancock's *Theory of Elliptic Functions* will be welcomed by all mathematicians, physicists and engineers. It is a monumental work on the subject and is unique for the wealth of information and details that it provides. Written in a rigorous and yet readable style, the book contains an exhaustive account of the theory of elliptic integrals beginning with formulas establishing the existence, formation and treatment of all three types (rational, simply periodic, doubly periodic) and concluding with the description of these integrals in terms of the Riemann surface. The author develops the theories of Legendre, Abel and Jacobi first and then gives an exposition of the $P(u)$, $\zeta(u)$ and $\sigma(u)$ functions of Weierstrass. Finally both these are interconnected by means of the universal laws of Riemann, who provided the most general theory of analytic functions by introducing the surfaces on which algebraic integrals may be represented. The book *Elliptic Integrals* by the same author is rather elementary compared with the above one and gives an introduction

to elliptic integrals of the first, second and third kinds and in addition provides a few tables associated with these integrals.

In spite of the cheapness of the books, the quality of printing is of a high order and is comparable with any highly priced publication.

K. S. V.

Mathematical Theory of Compressible Fluid Flow. By Richard Von Mises. Completed by Hilda Geiringer and G. S. S. Ludford. (Academic Press Inc., New York; India: Asia Publishing House, Bombay-1), 1958. Pp. xiii + 514. Price \$15.00.

This is Volume 3 of the series of monograph prepared under the auspices of the Applied Physics Laboratory, the Johns Hopkins University. It could not be finished by Richard von Mises before his death in 1953. At that time he had written only the first three chapters. The work was completed by his wife Hilda Geiringer and G. S. S. Ludford, who with the help of other collaborators like C. A. Truesdell have brought the work up-to-date by an exhaustive list of 'Notes and Addenda' at the end of the book.

The first chapter deals with basic equations, influence of viscosity, heat conduction, wave equation, subsonic and supersonic flows. The treatment is very scientific and new ideas like the specifying equation are introduced, which in general, may not be the same condition of state. Both the distinguishing features and the common points of subsonic and supersonic flows are brought out neatly. In chapter II general theorems are given on vorticity, irrotation motion, limit lines, hodograph representation and theory of characteristics. A number of examples are discussed in detail.

Chapter III deals with one-dimensional flow with viscosity and heat condition and discusses steady, unsteady flows and wave motion. The theory of shocks is discussed in great detail.

Chapter IV deals with plane steady potential flow. The hodograph method is fully discussed. A number of transformations are described. The following one given by the reviewer is not noted:

$$\begin{aligned}\phi_1 &= \rho_1^{-1} \cdot \phi, & \rho_1 &= \rho^{-1} \\ \psi_1 &= \rho^{-1/2} \cdot \psi, & \rho_1 &= \rho^{-1/2} \\ \nabla^2 \phi_1 &= \frac{\nabla^2 \phi}{\rho_1}, & \nabla^2 \psi_1 &= \frac{\nabla^2 \psi}{\rho_1} \\ \phi_1 &= \frac{\phi}{\rho_1}, & \psi_1 &= \frac{\psi}{\rho_1}\end{aligned}$$

The last chapter develops Chaplygin's Method, shock theory and transonic flow. There are selected reference books at the end, an author index and a subject index.

The book does not lay much stress on the physical side of compressible flow. The mathematical side is very rigorously dealt with and will provide a great inspiration to any one interested in the subject. The historical side of the subject is fully dealt with in 'Notes and Addenda'.

B. R. SETH.

Electronic Measuring Instruments. Second Edition. By E. H. W. Banner. (Chapman & Hall), 1958. Pp. 496. Price 56 sh. net.

Electronic instruments have surpassed in their usefulness all the previously known aids of the pure and applied scientists for accurate measurement and indication of electrical as well as non-electrical quantities. In recent years the development of electronic computing machines which carry out calculations with unimaginable speed and reliability, humanly impossible otherwise, is a remarkable achievement of the electronic engineers whose ingenuity in devising novel circuits seems to be the only limit to the marvels that electronics can play.

Employing certain well-known properties of electron tubes and circuits, a variety of measuring instruments are available commercially. Although scarcely any knowledge of the anatomy of such instruments and the principles involved in the circuitry employed therein on the part of the user is demanded, such a knowledge would satiate many inquiring minds. The book under review is intended to convey such information. The matter is divided into four parts. Part I: The characteristics of indicating instruments used with electronic devices. Part II: Electronic devices used in measuring instruments. Part III: Electronic instruments using the devices of Part II. Part IV: Quasi-electronic instruments and electronic devices used directly.

In Part II are discussed the fundamental characteristics of hot and cold-cathode valves, cathode ray tubes, photoelectric tubes, metal rectifiers and semi-conductor devices. The basic circuits in which these electronic devices are employed are briefly discussed. In Part III instruments using these are described. Of these, one finds detailed presentation of photoelectric measuring instruments and radiation measuring instruments. In Part IV instruments for measurement of non-electrical quantities such as vibration and strain measurement employing electromechanical transducers, automatic recorders, devices for the measurement of vacuum and a number of miscellaneous instruments are

discussed. The treatment adopted a nonmathematical, brief and does provide basic knowledge of the instruments. References to other books and papers for further reading for those who might be interested are also given.

Chemists and physicists would particularly find this publication useful as also instrument engineers.

A. J.

Conformal Transformations in Electrical Engineering. By W. J. Gibbs. (Chapman & Hall Ltd.), 1958. Pp. viii + 219. Price 45 sh. net.

For more than a decade now, publishers of text-books have been bringing out books on mathematical topics, which we are assured are specifically written for engineers and/or physicists. Sooner or later we find a book on almost every branch of mathematics on our book shelves designed for the engineer or the physicist. Some regret this trend, others hail it, but that is largely a matter on one's predisposition.

This book, on conformal transformations in electrical engineering, goes even one step farther in this direction. It is written for electrical engineers by an electrical engineer with the object of acquainting the practising engineer with the technique of conformal transformation in the solution of the practical problems in electrical design. As one would expect then, the style and exposition are not those of the mathematician or his new cousin, the theoretical engineer, who sometimes likes to rival him in his mathematical style. So much about the general flavour.

Although one of a series of advanced engineering texts, the book begins at an elementary level, the notions of complex numbers, central fields of force and mapping being developed in the first five chapters. The reader is then introduced to the Schwartz-Christoffel transformation which forms the central theme of this book. In working out special cases of the S-C transformation, the author develops the concepts of elliptic integrals and functions and other special functions like the Jacobi's Zeta and Theta functions. A number of problems involving S-C transformations of regions containing one or more right angles have been worked out in detail with appropriate discussions of their engineering significance. Particular mention may be made of the treatment of Carter's work on the problem of the field distribution between two poles separated by an

air gap, one of the poles having slots cut in its face.

This book has distinctive merits to recommend it to those for whom it is intended. Devoid of mathematical sophistication, it presents the conformal transformation as the logical tool to be used in the solution of a certain class of problems in electrical machine design. Most of the chapters are short enough to give the novice a break in assimilating the new ideas as he encounters them.

The author has guarded himself against a possible accusation that the application of conformal transformation in other fields like elasticity and fluid dynamics has not been treated, by his careful choice of the title. However, conformal transformations have an equally wide field of application in radio and electronics in the design of many types of electron tubes which is still a branch of electrical engineering. The total absence of any reference to this important field limits the use of this book to only those concerned with electrical machinery.

B. S. RAMAKRISHNA.

Dairy Microbiology. By E. M. Foster, F. E. Nelson, M. L. Speck, R. N. Doetsch and J. C. Olson, Jr. (Macmillan & Co., Ltd., London), 1958. Pp. 492. Price 42 sh.

This text-book of Dairy Microbiology is a very welcome addition to the existing books on this subject. During the last 15-20 years considerable advances in various branches of Dairy Microbiology have been made and the present attempt of the authors, who are well-known research workers and teachers in this subject at different American Universities, is worthy of highest commendation. The book is divided into 15 major chapters, dealing with different topics such as micro-organisms of milk and dairy products; methods of controlling growth of micro-organisms; destruction of micro-organisms by physical and chemical agents; microbiological methods of examining dairy products; microbiology of milk on the producing farm; microbiology of market milk and related products; microbiology of condensed, concentrated and evaporated milks; microbiology of sweetened condensed and dry milk products and microbiology of ice-cream and related frozen products. In addition, there are chapters devoted to microbiology of lactic cultures, microbiology of fermented milks, microbiology of cheese, microbiology of cream and butter and there is a useful chapter on dairy plant waste disposal and utilisation of by-pro-

ducts. All the topics are dealt with in an exceedingly lucid style and besides giving a historical background, the fundamental principles involved, the most recent advances in each of these aspects and their practical applications in the industry have been clearly brought out. The chapters on milk on producing farm and market milk and related products are particularly useful and methods of cleaning and sanitization of utensils have been very thoroughly discussed. Also in the chapters on microbiology of lactic cultures as well as of cheese, the discussion is very thorough incorporating the latest published literature. The book is full of good illustrations and has got an excellent subject index.

In this country with the growing interest in starting of milk supply schemes and in the organisation of milk industry by the States and private enterprises, this book on Dairy Microbiology is bound to be very popular with all workers engaged in quality control work or teaching and research work in the field of dairy microbiology.

K. K. IYA.

Indigenous Drugs of India. Second Edition. By R. N. Chopra, I. C. Chopra, K. L. Handa and L. D. Kapur. (U. N. Dhur and Sons Private Ltd., Calcutta-12), 1959. Pp. xxxii + 816. Price Rs. 50-00.

The first edition of the book under the title 'Indigenous Drugs of India, their Medical and Economic Aspects' appeared exactly twenty-five years ago in 1933. Since then the senior author had remained quite active and had collected all the necessary literature, etc., in this connection and has brought out a Second Edition of the book which will be of real help to all those who are working in the field of indigenous drugs. Col. Chopra's experience in this field for over thirty years gives this volume the stamp of authority as a reference material and a book to be referred to by everybody.

The contents have been broadly classified into five parts as in the First Edition. Besides, one Addendum and three Indices also have been added.

Part I is devoted to the medical and economic aspects of Indian Indigenous Drugs. Detailed account has been given about a historical and general survey of the Indigenous drugs. Some new chapters describing the preparation of Indian Pharmacopoeia, co-relationship of botanical classification of plants, their chemical constitution and physiological properties and newer trends in drug research have been included.

Part II deals with the potential drug resources of India with particular reference to pharmacopoeial drugs of India. This part includes the list of British and Indian Pharmacopoeial drugs growing in India.

Part III includes the drugs used in the indigenous medicine. This part has been further divided into two sections. Section I includes drugs of vegetable origin. This section includes many more drugs as compared to what it was in the First Edition. The authors have tried their best to give the complete information about the plant's botany, chemistry and pharmacology and also its clinical and therapeutic trials. Wherever necessary economics of its cultivation has also been discussed.

Similarly Section II gives detailed account about the drugs of mineral and animal origin. The mode of preparation, the pharmacology and the therapeutic trials of some well-known 'Bhasmas' have been dealt with in details. There is also a very good chapter on the drugs of animal origin, e.g., on musks and cobra venom, etc.

Part IV of the book includes the Indian Materia Medica and is divided into four sections. The first section contains a list of vegetable, inorganic and animal products, commonly used in Unani and Ayurvedic systems of medicine. Section II is mainly devoted to the description of plants having (i) poisonous properties, (ii) plants producing dermatitis, (iii) reputed abortifacient and emmenagogue plants and (iv) insecticidal and piscicidal plants. Section III gives a list of plants claimed to have antiseptic or antitubercular or antidysenteric properties or the plants which are reputed to be effective against Cholera, Snake bite or Scorpion sting. Section IV is mainly devoted to aromatic or essential oil bearing plants. This gives a detailed picture about chemistry, pharmacology and therapeutic uses and the economics of these plants. Lichens, medicinal ferns and mushrooms have also been dealt with properly in separate chapters.

Part V which concludes the book deals with common bazaar medicines of India. There is a chapter on vernacular names and popular uses. Besides, an addendum and three indices dealing with (i) vernacular and popular names, (ii) chemical constituents and (iii) scientific names, have been added by the author to facilitate easy reference.

The present edition is undoubtedly the result of practical experience as well as hard labour and this task has been done very creditably. The printing and get-up of the book are of a

high order. The authors as well as the publishers should be congratulated for bringing out such a useful volume.

B. MUKERJI.

Metabolism of Lipids. (Published by the Medical Department, the British Council, 65, Davies Street, London W. 1). (*British Medical Bulletin*, Vol. 14, No. 3), 1958. Pp. 197-278. Price 20 sh.

Though not exhaustively covering the entire field of Lipid Metabolism, the articles presented in this Bulletin review most of the major issues that are in the forefront of this rapidly expanding field of study. Biosynthesis of fatty acids in various animal systems, with acetate as the precursor, has been reviewed in detail by Hele. "B oxidation in reverse" is broadly the process involved in the synthesis. Divergence in the anabolic and katabolic reactions as being due to the differential distribution of enzymes and co-factors in mitochondria and microsomes and the specificity of synthetic system in the mammary gland are interesting features of this review. The discovery of mevalonic acid and its significance as a precursor of cholesterol and the possibility of this compound acting as a key intermediate in the synthesis of many steroids is discussed by Cornforth and Popjak. Of the many factors influencing the biosynthesis of fat, Folley and McNaught have discussed the effect of endocrines on lipogenesis in the mammary gland. Utilizing this sensitive tissue and elegant isotope techniques, the role of insulin, glucagon and steroid hormones of adrenal cortex on lipogenesis has been studied. "The hormonal control of the circulating lipids" by Oliver and Boyd forms the continuation of the absorption studies. The fundamental change in concept that glycerides need not be broken down to fatty acids and glycerol, before absorption of lipids from intestines; some of the outstanding problems in the cellular and distributive phases of fat absorption and faulty intraluminar emulsification of fat in human subjects are the features of Frazer's article on 'Fat absorption and its disorders'. The importance of lipoproteins, both in absorption and in the transportation of lipids in the blood stream and the mechanisms of the removal of chylomicron lipids and unesterified fatty acids from the blood are some aspects of lipid metabolism presented in other chapters.

Diseases of the coronary arteries and disorders of the cardiovascular system, constitute major medical and public health problems of

today. The intimate relationship between the increasing incidence of ischaemic heart disease, and the derangement of lipid metabolism; the essential fatty acid theory envisaging the importance of certain poly unsaturated fatty acids, viz., linoleic and arachidonic acids in the causation of skin diseases and coronary artery involvement; the effect of fatty acids on coagulation and thrombosis and other advances in our knowledge of lipid metabolism in relation to human diseases are very ably presented and constitute highly informative chapters of this volume.

M. SIRSI.

Advances in Veterinary Science, Vol. III. Edited by C. A. Brandly and E. L. Jungherr. (Academic Press, Inc., New York; India: Asia Publishing House, Bombay-1). Pp. xi + 579. Price \$13.00.

The present volume, the third in the series of the "Advances in Veterinary Science", contains nine essays written by people active in and familiar with specific areas of the different branches of veterinary science and animal husbandry. Of the ten authors, dealing with different subjects, 5 are from U.S.A. It would be advantageous for editors, Brandly and Jungherr, to concentrate on lesser number of topics giving thereby greater attention to a detailed and exhaustive survey in selected fields of veterinary research.

A varied fare is offered to the reader. Thus, the first review in this issue is by L. W. Hall and covers anaesthesiology. Therein, the author has discussed the principles and practice of veterinary anaesthesia with special reference to premedication, narcosis, relaxation and analgesia, including the use of antidotes and has very ably reviewed the recent advances in this field. The treatise will prove highly useful to veterinary surgeons engaged in work on operative surgery in the different species of domesticated animals and birds as well as students of surgery undertaking advanced studies in this subject.

J. R. M. Innes and I. Z. Saunders have written, jointly, the second essay on "Disease of central nervous system of domesticated animals and comparisons with human neuropathology". A distinguishing feature of this article, the only one of its kind in veterinary neuropathology, is the compilation, in over hundred pages of all that is known about veterinary neuropathology, serving as an excellent source of information in a concise form, and of references to the litera-

ture on the particular topics covered in this comprehensive review.

The third, fourth and fifth articles deal with brucellosis in cattle (Thomsen), sheep and goats (Renoux) as well as swine (Cameron). Thomsen has summarised the work done in Scandinavian countries on several aspects of bovine brucellosis, which made possible the successful launching of a scheme for eradication of this disease from these countries. This may be of assistance in planning a similar campaign in India. Renoux has brought together data on brucellosis in goats and sheep, scattered very widely in the literature and it is pleasing to note that this reviewer has taken due notice of research work carried out in different parts of the world including India. He has succeeded in his stated purpose of bringing out the interest in and importance of caprine and ovine brucellosis as hazards to the health of man and animals. Cameron has dealt with swine brucellosis, with special reference to epidemiology, diagnosis and eradication, which is the shortest article in this book, the several other parts of which form a balanced and acceptable collection.

Similarly, the sixth and seventh articles on "Helminthic diseases" (Gordon) and "Antine-matodal drugs" (Jones) are both thought-provoking, comprehensive and lucid in their scope and treatment of the subject. The section dealing with immunity in helminthic diseases is a redeeming feature of this review article by Gordon.

Vendeplassche has written an exhaustive review on "Artificial insemination of cattle with special reference to fertility and disease control". The author, in his concluding remarks, poses numerous problems in the field of artificial insemination and its bearing on sterility, spread of diseases and transmission of lethal genic characters, that remain to be tackled and solution of which will necessitate "well-organised teamwork and a well adapted extension service" as important and indispensable links for application and control of artificial insemination in practice.

The last chapter on "Clostridial disease of animals" is a first-rate account of an important and exceedingly difficult subject by L. D. S. Smith, a very experienced worker in this field. This essay, constituting a critical summary of the recent literature, will be of great value to any worker who wishes to have an up-to-date account of all that is known about diseases of animals due to anærobes and will be especially

useful to any one undertaking research in this field.

As in volumes I and II, each part is followed by a copious list of references and selection of worldwide literature has been attempted. However, it would be a good addition to specify the time at which the survey of literature pertaining to the review was completed as a foot-note on the opening page of the practice in the Annual Reviews of Biochemistry, Microbiology, *et cetera*.

There is a useful subject index and author index at the end and the volume is sold at a very reasonable price. It is undoubtedly a very valuable acquisition for all scientists and teachers and practitioners who are interested in veterinary and allied research. The book is packed with information which is judiciously presented and will be equally useful to the advanced worker as well as the serious student. All the chapters are of a uniformly high standard and the volume will be a most useful addition to any scientific library. Further volumes in the series will be keenly awaited.

The editing has been done in a most scholarly manner, and regarding the printing and get-up of the book, suffice it to say that it is another academic press volume. However, a printing mistake has been observed on p. 324 where the last line "*et al.* (1953)" should be printed as 15th line of the first para following the word "Rick" in the 14th line.

I venture to suggest to the Advisory Board that, while choosing subjects for review, due recognition must also be given to diseases that take a heavy toll of livestock in South-East Asia, like Rinderpest and Hæmorrhagic septicæmia and global representation of authorship should include, as well, veteran workers in these fields in different countries of Asia.

M. R. DHANDA.

Cosmic Electrodynamics. By J. W. Dungey.
(Cambridge University Press, London N.W. 1).
1958. Pp. ix + 184. Price 32 sh. 6 d.

At the surface of the sun and of most stars, the temperature is so high that atoms are ionised and the motion of charged particles generates strong electric currents and associated magnetic fields. It is no wonder, therefore, that electrodynamics plays an important role in problems of astrophysics and especially in phenomena related to our nearest star, the sun. The book under review presents the diverse electromagnetic phenomena that occur in the stars and the sun, such as the magnetic fields in the sun

and the stars, magnetic storms and auroræ, the acceleration of cosmic ray particles and interstellar fields, while at the same time giving, as the title indicates, an introduction to the subject of magnetohydrodynamics.

The emphasis of the book is decidedly on the theoretical developments in the subject, though at some places factual information has also been provided. The discussion in the first chapter on the order of magnitude of quantities involved in problems of cosmic electrodynamics seems to be very appropriate, especially for this subject wherein phenomena occurring in huge stellar scale are built up apparently from tiny atomic particles, and this will give the reader a clear insight into the mathematical quantities that he is handling. After discussing the motion of magnetic fields and a few static problems, the author describes some dynamic phenomena, the most important among them being the propagation of the magnetohydrodynamic waves. These are waves that pass through the magnetic lines of force, if these are pictured as elastic strings. In chapter six, the author discusses the problem of the acceleration of particles to high energies, which is related to the riddle of the origin of cosmic rays. All primary cosmic ray particles have energies greater than 10^9 eV., and some have energies as high as 10^{17} eV. Since there is no other conceivable mechanism by which the particles could acquire such tremendously high energies except the acceleration by some electric field, the origin of cosmic rays becomes a problem of cosmic electrodynamics. Chapter seven dealing with solar phenomena departs from the main theoretical trend of the book and in it the author summarises our observational knowledge regarding the sun, its dark spots, prominences, flares, etc. One wonders whether this departure is necessitated because no satisfactory theory exists as yet to explain the origin of the sun spot magnetic fields, and the host of phenomena associated with the sun spots such as their periodicity, their magnetic fields, the polarity of the fields, the Evershed effect are still a mystery!

The book besides contains two chapters on magnetic storms and Auroræ and ionospheric electrodynamics which will be of interest to meteorologists particularly. The bibliography at the end gives a list of references to the important papers on the subject published during recent years.

K. S. V.

Books Received

Nomenclature of Plants. By Herold St. John. (The Ronald Press Co., 15, East 26th Street, New York-10), 1958. Pp. vii + 157. Price \$ 2.50.

Text-Books of Optics (for Advanced Studies). Part I. Geometrical Optics. By K. Ghosh, Art Union, 80/15, Grey Street, Calcutta-6), 1958. Pp. x + 480. Price Rs. 16-00.

British Medical Bulletin, Vol. 15, No. 1—*Haematology*. Edited by D. A. G. Galton. (Medical Department, the British Council, London W. 1), 1959. Pp. 83. Price 20 sh.

Tube and Semiconductor Selection Guide. Compiled by Th. J. Kroes. (Philips' Technical Library, Eindhoven; India: Philips India Ltd., Calcutta-20). Pp. 34. Price Rs. 5-00.

Physics of Meteor Flight in the Atmosphere. By Ernst J. Opik. (Interscience Publishers, New York-1), 1958. Pp. viii + 174. Price \$ 3.85.

Introduction to the Physics of Many-Body Systems. By D. Ter Haar. (Interscience Publishers, New York-1), 1959. Pp. viii + 127. Price \$ 3.85.

The Potential Theory of Unsteady Supersonic Flow. By J. W. Miles. (Cambridge University Press, London N.W. 1). Pp. xii + 220. Price 45 sh.

Screening Procedures for Experimental Cancer Chemotherapy. By C. Chester Stock and others. (*Annals of the New York Academy of Sciences*, Vol. 76, Art. 3). Pp. 409-970. Price \$ 5.00.

Symposium No. 6 of the International Astronomical Union—Electromagnetic Phenomena in Cosmical Physics. Edited by B. Lehnert. (Cambridge University Press, London N.W. 1). Pp. xii + 544. Price 50 sh.

Proceedings of the Third Congress on Theoretical and Applied Mechanics. (Indian Society of Theoretical and Applied Mechanics, Kharagpur), 1957. Pp. 362.

Genetical Theory of Natural Selection. By Ronald A. Fisher. (Dover Publications, Inc., New York). Pp. xiv + 291. Price \$ 1.85.

Elasticity, Plasticity and Structure of Matter. By R. Houwink. (Dover Publications, Inc., New York). Pp. xviii + 368. Price \$ 2.45.

SCIENCE NOTES AND NEWS

Asphondylia Sp. a New Record of Coccidomyid on *Sesbania speciosa* Flowers in Madras State

Sri. S. Venugopal, Agricultural College and Research Institute, Coimbatore, reports for the first time *Asphondylia* sp. a new record of Coccidomyid on the green manure crop *Sesbania speciosa* in Madras State.

Award of Research Degree

The University of Poona has awarded the Ph.D Degree in Physical Chemistry to Shri Mohan Chandra Tewari for his thesis entitled "Problems Connected with the Preservation of Timber".

First All-India Congress of Zoology—1959

The First All-India Congress of Zoology sponsored by the Zoological Society of India will be held at Jabalpur (M.P.) from October 24-29, 1959 on the invitation of the University of Jabalpur. Further information may be had from the General Secretary, Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta 12 (India).

The Society for Analytical Chemistry, London

Dr. N. Jayaraman, Director, Essen & Co., Bangalore, has been elected as a Member of the Society.

The Marine Biological Association of India

The Marine Biological Association of India was founded at Mandapam Camp, to promote interest in marine biological and cognate sciences. The Association was formally inaugurated by the Hon'ble Mrs. Lourdhammal Simon, Minister for Fisheries and Local Administration, Madras State, on January 3rd, 1959. The following Office-bearers were elected: Dr. S. Jones (President), Prof. R. V. Seshaiya (Vice-President), Dr. R. Raghu Prasad and Dr. C. P. Gnanamuthu (Secretaries), Dr. R. P. Varma (Asst. Secretary), Shri K. V. Rao (Treasurer), Dr. P. N. Ganapati (Editor), Dr. R. Subrahmanyam (Joint Editor), and Dr. S. V. Job (Managing Editor). The official organ of the Association, the "Journal of the Marine Biological Association of India" is expected to be issued half-yearly. Membership is open to

all interested. All correspondence may be addressed to the Secretary, Marine Biological Association of India, Marine Fisheries P.O., Mandapam Camp, South India.

Helium Separation by Diffusion

A diffusion technique for the separation of helium from a mixture of gases has been elaborated at the Bell Telephone Laboratories, U.S.A., and it promises to have application to the commercial isolation of the element from natural gas. Differential diffusion through glass is the principle employed and silica glass, which has a permeability to helium 1,000 times that to hydrogen, has been found the most efficient permeable material.

To obtain appreciable quantities of helium, the elaborators of the technique, K. B. McAfee and H. Kraft, point out, a large surface of glass must be exposed to the mixture, the glass must be thin, and a high pressure differential maintained between the two sides of the glass. In practice a bundle of the capillary tubes, each with one end sealed off, is encased inside a large glass or steel pipe, through which natural gas or impure helium is passed. The open ends of the capillary tubes are sealed into a common header which takes off the helium that diffuses through the walls.

Silica or Pyrex which can be drawn to tubing having an external diameter of 2/1,000 in., and a wall thickness of 2/10,000 in., and is capable of withstanding a compressive stress in excess of 1,000 atmospheres, is ideal for the separation of helium. It will withstand temperatures of more than 400° C. over long periods without deteriorating, and tests have indicated that a cell containing enough capillaries to occupy about 2 cu. yd. would pass nearly 1,000 cu. ft., a day of helium at room temperature with a pressure differential of 1,000 atmospheres, assuming a concentration of 1% helium. At 400° C. it would recover 1,000,000 cu. ft., of helium a day. A cell of that type might be placed directly in a gas pipeline for industrial use. A single diffusion step, it is claimed, yields helium containing less than 0.0009% hydrogen from a 90:10 hydrogen-helium mixture.

The only present producer of helium in the U.S.—the Bureau of Mines—has established several low-temperatures recovery plants in the

South-West to salvage some of the helium from especially rich, natural gas-helium mixtures. However, most wells do not produce a rich-enough mixture to warrant building such plants, so most of the natural gas-helium mixture is used for fuel, and the volume of helium so lost amounts to more than 10 million cu. ft. a day.—*Science Newsletter*: 4722-A.

Magnetism in the Galaxy

The 250 ft. steerable radio telescope at Jodrell Bank is being used by R. Hanbury Brown and colleagues in an attempt to measure the magnetic fields prevailing in the gas between the stars of our galaxy, the Milky Way. The telescope picks up radio waves from the very powerful radio star in the constellation of Cassiopeia. A cloud of gas in front of the radio star absorbs the radiation at the natural radio frequency of the hydrogen atoms, 1420 Mc./s. (21 centimeters wavelength).

If a magnetic field operates in the gas, the frequency of absorption is split into two frequencies by what is well known to physicists as the Zeeman effect. The magnetic field is expected to be extremely feeble (about a hundred-thousandth of a gauss) so that the separation of the frequencies would be only about 30 cycles per second.

Equipment to detect such a small difference has been devised by the Dominion Observatory of Canada, and makes use of different "polarisation" states in the two absorbed frequencies. The aerial employed consists basically of a waveguide containing two detecting probes inserted at right angles to each other.

The experiment began on 1st January, and has not yet been successful.—*The New Scientist*, February 1959.

Earth's Albedo

The earth's albedo, i.e., the measure of its reflecting power, is indicative primarily of the properties of its atmosphere, and is of great interest as a characteristic of the earth as a planet in the solar system.

The value of the reflecting power of the earth has been redetermined recently by Andrei Kharitonov of the Alma Ata Observatory, as part of the IGY programme. The method employed was to compare the brightness of the moon's crescent (the part of its surface lit by the direct rays of the sun) with the brightness of the part of the moon lit by solar rays reflected from the earth. An albedometer designed at the Observatory was used in this determination. The new value for the albedo is 0.38 as com-

pared to the earlier calculations of 0.39 by the French Scientist Andre Danjeon, and 0.42 by the Alma Ata Astronomer Kazachevsky.—*Soviet News*.

Particle Accelerator with Varying Magnetic Field

A cyclic accelerator with spatial magnetic field variation has been developed at the Joint Nuclear Research Institute, Dubna, near Moscow and has been in operation since January 1959. The existing types of charged particle accelerators are not sufficiently powerful to meet the growing requirements of nuclear physicists, especially with regard to the intensity, that is, the number of accelerated particles in the beam emerging from the machine. Development work on such accelerators is under way in many countries, especially, U.S.A. and Britain.

The new Soviet accelerator is distinct from the others in that the magnetic field instead of being constant is made to vary in space so that the field's lines of maximum tension fall into an Archimedes spiral. With this new type it is expected to produce particle beams thousands of times more intense than are obtained in the hitherto known high energy accelerators.

A report on the new accelerator has been sent to the international "Nuclear Instruments" magazine brought out in Amsterdam.—*Soviet News*.

Wax and Oil Recovery from Rice Bran

A practical method has been developed in America for recovering both oil and wax from rice bran in one continuous operation, using a single solvent, hexane. Previous methods for wax recovery required use of other solvents and at least two expensive steps for recovering both oil and wax. In the new method either of two procedures may be followed. In one, the oil is removed from the bran with cold hexane. Then hot hexane is used to extract the wax. Chilling the wax-hexane solution precipitates the wax, completing its recovery. The alternative procedure is to remove both rice oil and wax simultaneously by a single extraction with hot hexane. The wax is then precipitated by chilling and washed several times with cold hexane to remove any remaining oil. The rice wax recovered by the new method is a hard wax with a high melting point much like Carnauba and can replace the imported product in a number of uses.—*Chemical Products*, March 1959.

Nuclear Shapes

According to Rutherford's model of the atom it is customary to describe the nucleus as an extremely small, extremely heavy and extremely hard particle. While experiments have helped to fix the mass of nucleus to a high degree of accuracy, the question of its size, and more so its shape is still largely a matter of conjecture and depends on the nature of the experiments carried out for the purpose and the 'probes' used in them. These experiments include bombarding the nucleus with a variety of charged and neutral subatomic particles, probing the nuclear interior with its own atomic electrons and observing nuclear radiations. Although it is obvious that the size and shape of the nucleus can be described properly only in terms of actual experiments, an idealised model of the nucleus consistent with experimental facts will be an aid to stimulate further understanding of its structure.

The nucleus is composed of neutrons and protons bound together by nuclear forces, the origin of which appears to lie in their mutual interaction with pi-mesons. In attempting to know the size and shape of the nucleus two factors have to be considered, namely, the distribution of matter, i.e., the nuclear particles, and the distribution of the nuclear force fields. To assume the nucleus to be a sphere will be an over-simplification of what in fact is an extremely complicated system of particles and forces.

A great deal of evidence has recently accumulated indicating that many nuclei possess shapes which differ considerably from spherical symmetry. In an article in *Science* (129, February 13, 1959, p. 361) L. Wilets has summarized our present knowledge of the shapes of atomic nuclei. According to this there are certain "magic numbers" in nuclear physics. If the number of protons and the number of neutrons within a nucleus are both "magic" the shape of the nucleus is normally spherical—magic numbers correspond to conditions of unusual stability. These nucleonic magic numbers are 2, 8, 20, 28, 50, 82 and 126. Examples of doubly magic nuclei are oxygen-16, calcium-40, calcium-48 and lead-208.

Consider now a nucleus slightly larger than a doubly magic nucleus. An additional neutron or proton can rotate freely within the doubly magic "core"; in so doing they exert a centrifugal force and deform the nucleus into an oblate spheroid.

If, on the other hand, there is one fewer neutron or proton than is needed for a doubly

magic nucleus, this can be regarded as a hole, rotating in a similar way, but exerting a negative pressure on the nuclear surface. It thus deforms it into a prolate spheroid.

This simple view would suggest that midway between magic numbers in the table of isotopes there would be a switch from the oblate to the prolate: in fact, the prolate predominate.

There is also evidence that some isotopes in the neighbourhood of radium have pear-shaped nuclei.

Nuclear Raman Effect

Deformation of the nucleus shows itself as deviation of nuclear electric field from spherical symmetry leading to the quadrupole moment of the nucleus. A rotating or oscillating quadrupole can radiate or absorb electromagnetic energy. It is known that in nuclear photo-effect the cross-section for absorption of photons shows a giant resonance which varies with atomic weight from about 20 Mev. for light nuclei to about 14 Mev. for heavy ones.

In the case of nuclei with non-spherical equilibrium shape, the photo-effect will depend on the orientation of the nucleus with respect to the direction and polarization of the incident photon. Thus the giant resonance characterising the photo nuclear process is expected to split into two components corresponding to vibrations of the nucleus parallel and perpendicular to the axis of the spheroidal nucleus. Recently experimental evidence has been obtained for such a splitting.

Also the dependence of the photo-effect on the nuclear orientation provides at the same time a coupling to the rotational motion. The scattering of photons will be accompanied with the excitation of rotational states. The phenomenon is analogous to the Raman Effect in molecules.

In a paper on "Nuclear Raman Effect" (*Nuclear Physics*, 10, 1959, No. 2) Maric and Möbins have discussed the dependence of the photo-effect on the nuclear orientation and computed the cross-section for the Nuclear Raman Effect in the case of inelastic scattering of gamma-rays accompanied with the excitation of rotational states of strongly deformed nuclei.

An experimental study of such processes might provide additional information about the structure of the photo-resonance in deformed nuclei.

New Value for Earth's Oblateness from Measurements of Satellite Orbits

The oblateness of the earth is defined as the difference between the equatorial and polar

radii divided by the equatorial radius. The accepted value for this ratio is $1/297.1$. A more precise value has been calculated making use of the data on the orbits of artificial satellites.

The main perturbations to the orbit of a near Earth-satellite are caused by (a) the oblateness of the earth and (b) the drag of the earth's atmosphere. The effect of air drag is to reduce steadily the length of the major axis and the eccentricity of the orbit, while the effects of the polar flattening are (i) to rotate the orbital plane about the earth's axis and (ii) to rotate the major axis of the orbit in the orbital plane. Of these perturbational effects, the rotation of the orbital plane which can be measured very accurately should provide new information about the earth's gravitational field in which the satellite moves.

In an article in *Nature* (182, September 6, 1958, p. 640) R. H. Merson and D. G. King-Hele have described a method of exploring the earth's gravitational field from analysis of kinetheodolite observations of satellite orbits. The usual expression for the gravitational potential due to the earth (of equatorial radius R) at an external point distant r from the centre, contains in addition to the main first order term (R/r) , the perturbation terms of the second and fourth harmonics, viz., $(R/r)^3$ and $(R/r)^5$, whose coefficients may be taken as J and D respectively. The expression for the mean rate of rotation of the orbital plane for a near earth-satellite in this gravitational field involves the coefficients J and D , and the orbital angle θ . From the data available for the orbits of Sputnik II ($\theta = 65^\circ$) and Vanguard I ($\theta = 34^\circ$), Merson and King-Hele have obtained the values, $J = 1624.6 \times 10^{-6}$ and $D = 6 \times 10^{-6}$ (*Nature*, 183, March 28, 1959, p. 881). From these values of J and D , the new value for earth's oblateness has been calculated as $1/298.20$. From information available on Explorer IV ($\theta = 50^\circ$), it has been found that the sixth harmonic of the order of 10^{-6} , does not significantly affect the above value.

Early Tetrapod Life

The first tetrapods arose in the Devonian period. The evidence indicates that this was a time when the land areas in which the tetra-

pods evolved were subject to seasonal droughts or periods of aridity. A. S. Romer has suggested on various occasions that tetrapod limbs did not develop as an adaptation to terrestrial life itself, but, rather, as an adaptation which would assist an aquatic animal living under drought conditions to shift from drying pools to those that were less fleeting.

In a recent paper Romer [*Evolution*, 12, 365 (September 1958)] emphasizes that there were two distinct chapters in tetrapod history : (i) development of limbs giving potentiality of terrestrial existence, and (ii) utilization of these limbs for life upon the land. These two events need not have occurred synchronously ; in fact, Romer believes that they were separated in time by many millions of years. The development of limbs took place during the Devonian period, when the climate and lack of available food supply on land did not favour terrestrial vertebrate life. The beginning of actual life on land did not occur until the upper Carboniferous period, very probably during late Pennsylvanian time, when the world climate and the evolution of insects made available the supply of animal food necessary for the existence of terrestrial vertebrates.—*Science*, Vol. 129, p. 533, 1959.

Relocation Links Clifton, New Jersey, with London

Mr. Edward Reeve Angel, Chairman of H. Reeve Angel & Co., Ltd., of 9, Bridewell Place, London, E.C. 4, England, is pleased to announce that their Associate Company in the United States of America is building a new modern air-conditioned one-story office and plant about ten miles from New York City in Clifton, New Jersey.

Mr. Angel's Father, Mr. Harry Reeve Angel, founded H. Reeve Angel & Co., Inc., forty-four years ago to distribute the famous Whatman brand filter and drawing papers made by W. & R. Balston, Ltd., Maidstone, Kent.

In recognition of the close relationship between the Reeve Angel Companies, the American Company has been successful in designating the street and number of their new plant 9, Bridewell Place, the same as the London Company.

THE STATISTICAL CHARACTER OF ATOMIC PROCESSES

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THERE still lingers a popular view of science (which scientists did much to encourage and nothing to dispel), according to which a scientific theory is accepted when it is in accord with *all* the facts it purports to describe: hence the unrockable certainty of scientific statements in contrast to the frailty of human judgments of other origin. Apart from the obvious tautology implied by the consideration of the totality of the evidence, this naive picture of the way in which science is made is as remote from reality as the meticulous preciseness of pre-Raphaelite painting. Physicists know very well, when they are at work (although they do not usually put it down in so many words when they write about their work), that their decisions to adopt or reject theories are always based on a *very small* number of facts, which they regard as crucial.

This behaviour of the physicist is not as reckless as it seems; not more so, in fact, than that of the engineer wanting to assess the strength of a steel girder: he will not probe every inch of it, but only perform a small number of adequately distributed *sample* measurements. Likewise, the scientist proceeds by *sample* tests of his theories and relies upon this sampling in assessing their adequacy; whether the sampling is judicious, or how extended is its scope, can only be ascertained by trial and error. Thus, in science as in every other walk of life, all decisions, all actions are taken on the strength of truth-judgments which are of a fundamentally statistical character. There is here no sharp distinction between 'practical' and 'philosophical' truth: attempts to draw such a distinction have only led to 'Scheinprobleme', as for instance the very problem of the 'foundation' of statistical causality.

Mathematicians know that the concepts and axioms of the theory of probabilities form a self-contained logical system which does not need any extraneous foundation. Professional statisticians use this theory as a tool perfectly adapted to their needs, and never had any qualms about its 'ultimate' justification. Only the physicists, by their uncritical acceptance of a deterministic philosophy, were long prevented from recognising in statistical causality the actual form of all scientific reasoning. When, however, in order to formulate in rational terms (*i.e.*, without running into *trivial* contradictions) the fundamental laws of atomic processes, dominated by the existence

of the quantum of action, it was found necessary to introduce *complementarity* as a new kind of logical relationship between physical concepts, it became clear that the causal links between atomic phenomena are no longer necessarily determinate, like in classical physics, but do indeed belong to the more general, statistical types.

The stumbling block to the understanding of complementarity and the appreciation of its significance is undoubtedly the belief in the absolute validity of the deterministic form of causality: for those who entertain this belief, statistics must appear as an incomplete mode of description, which has to be based upon some deterministic substratum. Thus, by postulating the necessity of such a substratum in the atomic case, they create for themselves the problem of finding it,—without realising, apparently, the deceptive character of such an argument.

The traditional conception of determinism is not so simple as it looks. The idea is that, if you know all the *relevant* circumstances at some instant, you are able to predict in a unique way what is going to happen next. The restriction implied by the word 'relevant' is obviously essential in order to avoid a tautology: but the very necessity of thus selecting from the infinite wealth of events only a limited number of data on which inferences about the future (or the past) are to be based emphasises the highly abstract character of deterministic causality. That such inferences should at all be possible, that it should be possible to set up differential equations involving only a few variables and allowing valid predictions or retrodictions about the states describable in terms of these variables, is indeed very remarkable; but it is a situation of fact, a 'law of nature', and as such it partakes of the limitations inevitably affecting all the concepts and statements by which we try to express in finite terms the salient features of an infinite reality. No doubt, the domain of validity of determinism as the form of causality characteristic of the laws of matter, in bulk—the laws of motion of material bodies as well as those of electro-magnetic radiation and gravitation—is so vast that it was natural to regard this type of causality as the universal one, so long as there was no suggestion in experience of situations to which it would not apply: but it is fatal to lose sight of the

provisional character of conceptual extrapolations of this kind and to proclaim them 'necessary' features of reality.

In dealing with quantal processes, we are indeed faced with such a sharp dilemma that it is impossible to dodge it. The very definition of the quantum of action exhibits a seemingly paradoxical character, since the two quantities—energy-momentum and period-wavelength—whose product is equal to Planck's constant refer to mutually exclusive aspects of the atomic object, respectively idealised as a punctiform particle and an indefinitely extended plane wave. It is therefore clear that the existence of the quantum of action imposes a limitation to any analysis of an atomic process in terms of such classical idealisations, and thereby introduces a statistical element into the description. It is impossible, for instance, to assign the electron in a stationary state of the hydrogen atom a continuous motion along a trajectory in the classical sense, because such a motion would imply a continuous variation of action, in violation of the quantum law. The quantal transitions thus appear as phenomena only definable as a whole, in terms of the initial and the final state; and in view of the multiplicity of possible final states, their occurrence can only be characterised by relative probabilities. It is also clear that no introduction of 'new concepts' can have any influence on this situation, since such concepts (in order to be intelligible) must be somehow related to the classical concepts adapted to the account of our direct experience, and this relation must be compatible with the law of the quantum of action: thus, all typically quantal concepts, like spin or parity, are defined in classical terms, but their definition necessarily contains a statistical element.

It is of decisive importance for the consistency of quantum theory that the limitations imposed by the existence of the quantum upon the use of classical ideas should not be absolute, but only relative, and, in fact, reciprocal. Every classical concept corresponds to a situation which can be reproduced, in principle, with any accuracy by an appropriate experimental arrangement: but every such arrangement precludes (up to a reciprocal latitude) the possibility of defining the concept which characterises the complementary situation. This ensures that the statistical causality inherent in the description of quantal processes does not imply any incompleteness of this description. Complementarity provides a logical framework wide enough to comprehend

in a rational way those aspects of the atomic processes which, while mutually exclusive, are equally necessary parts of an exhaustive account.

In this connection, it must be stressed that the requirement of completeness cannot be formulated absolutely, but depends on the type of causality of the mode of description envisaged: it is different for a deterministic and for a statistical theory, and it is unreasonable to demand from the latter that it should conform to criteria applicable to the former. Failure to realise this has led to a curious misapprehension of the consequences of the reciprocal limitations of measuring processes for the completeness of the quantal description of the phenomena. When we have ascertained by observation some characteristic of a system, we have irrevocably deprived ourselves of the possibility of ever knowing anything about the complementary feature of this system: how then, it is asked, dare we assert that our description of the system can ever be complete? Here again, it is apparently overlooked that whatever observations are made upon atomic systems are in the nature of a *sampling*, a very minute sampling indeed of the innumerable identical systems which make up the universe. The identity of constitution of all atomic systems of the same species, implied in the formulation of such a fundamental law of nature as the exclusion principle, is quite essential for the atomistic picture of the universe to make any sense at all. Only this identity gives a meaning to probability statements about the behaviour of a system of definite species. The complementarity of different types of behaviour implies that we cannot observe these types of behaviour on the same sample; but we have many samples at our disposal, and the fate of a particular sample is of no interest: we are only concerned with predictions valid for *any* sample.

No less essential than completeness is the requirement of objectivity which every scientific theory must fulfil. Again, it is easily seen that the widening of our conception of causality implied in complementarity does not in the least conflict with this requirement as commonly understood. The argument which led to the recognition of the new form of complementary relation between quantal phenomena is a quite rigorous one: at no stage has any arbitrary postulate been introduced about what 'reality' ought or ought not to be like. It is true that in our account of atomic phenomena explicit reference must be made to the interaction of the

atomic objects with the systems of macroscopic bodies constituting the apparatus by means of which these objects are observed. But this circumstance, far from bringing in any subjective element, enables us to put the fundamental laws of quantum theory in a form valid for any observer, and accordingly objective in exactly the same sense as the laws of classical physics. It is clear that, strictly speaking, all physical concepts imply some reference to conditions of observation. In classical physics, we may usually forget about it and indulge in the illusion that we are contemplating the unrolling of the phenomena as a spectacle in which we have no part; when dealing with atoms, we must adapt our epistemology more closely to the real situation we occupy in the universe.

There is an undeniable similarity between the epistemological conclusions, drawn from the peculiar character of the quantal laws, about the active part of the observer in defining the phenomena, and the insistence of the early positivists on the essential part played by our sensations in determining our knowledge of the external world. This only means that, to that extent, the early positivist move-

ment was a healthy reaction against the shallow metaphysics of mechanistic materialism. But why should scientists be made responsible for the later positivists' blundering into a metaphysics of their own? No scientist would accept the extreme positivist contention that there is nothing more in statements about phenomena than the conceptual expression of relations between sensations: he would maintain that such statements refer primarily to real processes of the external world; our mental representation of these processes being itself, of course, subject to definite laws depending upon our sensorium.

Clearly, the point of view of complementarity finds its natural place in the line of development of a philosophy rooted in a straightforward common sense approach to the realities of existence,—a philosophy which historically found its most vigorous expression in Josef Dietzgen's early writings. This is the true line of development of the philosophy of science, because on the one hand scientific thought can only thrive if it is in harmony with the social function of scientific activity, and on the other hand all philosophical abstractions can only find in science a sure foundation.

TRAPPED RADIATION AROUND THE EARTH

INVESTIGATIONS with the help of satellites and space probes have resulted in the discovery of a new phenomenon which is of great scientific interest in space research. Whereas in many cases the findings from the cosmic ray counters and radiation detectors carried by early satellites were in full agreement with theory and had been predicted for some years, there were also surprising facts.

Sputnik II, launched on November 3, 1957, carried a single shielded Geiger counter to measure cosmic ray counting rate. The data received showed that the counting rate increased almost linearly from 30° N. to 60° N. geomagnetic latitude at a constant altitude. As a function of the altitude the rate increased gradually from 225 to 700 km. During the flight, however, an unusual "event" occurred when the counting rate increased by 50%, and there was no correlation with any event noticed on the ground. Later experience gathered from Sputnik III, launched on May 15, 1958, revealed that there is an electron flux north of 60° N. at relatively low altitudes, and it became evident that the "event" observed with Sputnik II was a part of this phenomenon.

Again, the first U.S. IGY satellite, Explorer I, launched on February 1, 1958, had as its primary purpose the study of cosmic radiation in the vicinity of the earth. The observations with this satellite, as well as those with Explorer III, launched on March 26, 1958, led to the discovery of the existence in the region around the earth of a belt of high intensity corpuscular radiation due to natural geophysical causes.

The first report of this discovery and its interpretation in terms of magnetic trapping was given by James A. Van Allen, on May 1, 1958, at an IGY Symposium of the National Academy of Sciences and the American Physical Society. To secure more detailed knowledge of the structure and extent of these radiation belts, now known as the Van Allen Belts, it was felt necessary to collect data of observations carried to very great radial distances, several times the earth's radius. The joint venture, under US-IGY operations, of the State University of Iowa, the Jet Propulsion Laboratory of the California Institute of Technology and the U.S. Army Ballistic Missile Agency, has yielded extremely significant

results gathered from the deep space probe, Pioneer III.

A preliminary outline of these results is given by Prof. James A. Van Allen and Louis A. Frank in *Nature*, February 14, 1959, from which the relevant data given in this note have been taken.

Log of flight (Pioneer III) launched from Cape Canaveral, Florida, at 0545 U.T., December 6, 1958. 28°5' N. 80°8' W.) Burn-out velocity (space fixed) 10·68 km./sec. Apogee :

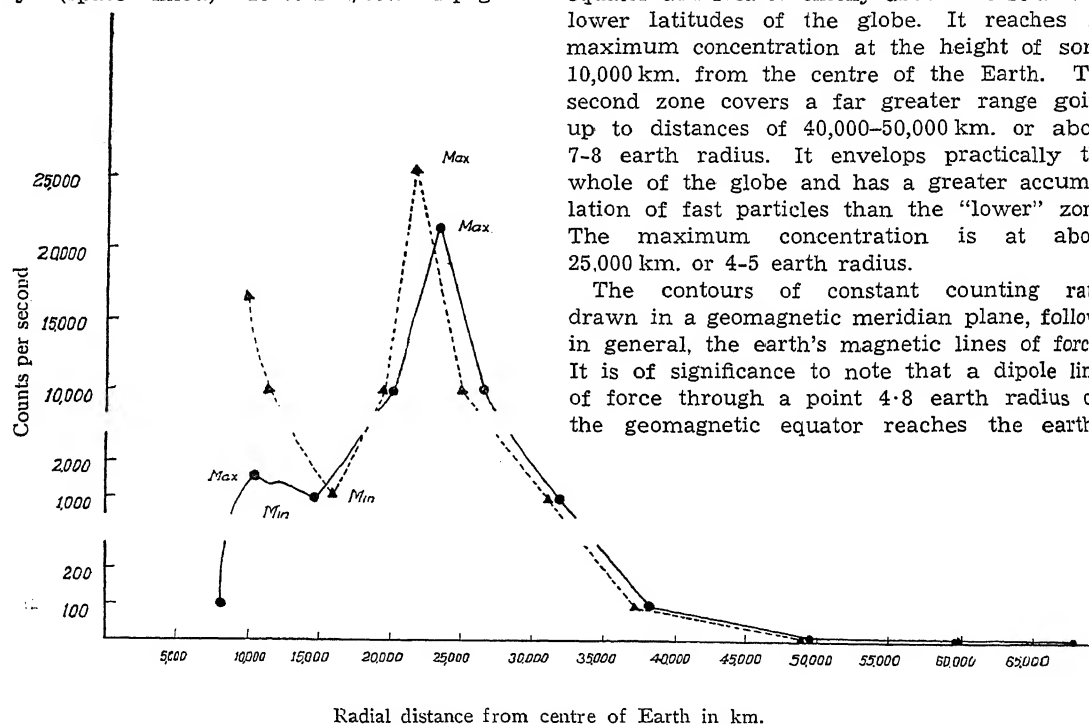


FIG. 1. Plot of counting rate *versus* radial distance from centre of Earth, in the Pioneer III observation. Continuous curve shows the out-bound leg of the flight, December 6, 1958, 0549-1410 U.T. Dotted curve shows the in-bound leg of the flight, December 7, 1958, 1520-1930 U.T. Note: Three different scales are used in the ordinate, indicated by breaks in the curves.

108,700 km. radial distance from centre of Earth, 23°74' S., 145°5' E. at 0049 U.T., December 7. Extrapolated impact with the Earth: 16°18' N., 20°30' E., at 1943 U.T., December 7.

During its flight of 38 hrs., Pioneer III was tracked by the JPL tracking stations for 25 hrs., the maximum time it was above the horizon for these stations.

Due to excellent telemetry, continuous radiation observations were obtained on the out-bound leg of the trajectory to a radial distance from the centre of the Earth of 107,400 km. (nearly to apogee) and from 60,000 km. to 9,400 km. on the in-bound leg.

The curve Fig. 1, shows the plot of the counting rate against distance from the centre of the earth, along the trajectory. It will be seen that there are two distinct, widely separated zones of high intensity. Detailed analysis of the data from Pioneer III, together with those obtained from the Sputniks and other satellites, shows that in a geomagnetic meridian plane, the first zone is a dough-nut-shaped region centred on the geomagnetic equator and located chiefly above the relatively lower latitudes of the globe. It reaches its maximum concentration at the height of some 10,000 km. from the centre of the Earth. The second zone covers a far greater range going up to distances of 40,000-50,000 km. or about 7-8 earth radius. It envelops practically the whole of the globe and has a greater accumulation of fast particles than the "lower" zone. The maximum concentration is at about 25,000 km. or 4-5 earth radius.

The contours of constant counting rate, drawn in a geomagnetic meridian plane, follow, in general, the earth's magnetic lines of force. It is of significance to note that a dipole line of force through a point 4·8 earth radius on the geomagnetic equator reaches the earth's

surface at a geomagnetic latitude of 63°, and one through a point 10 earth radius, at a geomagnetic latitude of 71·5°. These latitudes are approximately the lower and upper boundaries of the usual zone of maximum auroral activity.

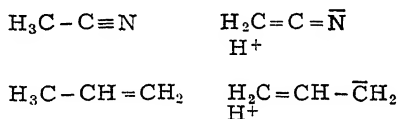
The origin of these trapped radiation belts is still a matter of conjecture. Various explanations have been given but it is generally believed that the inner and outer zones may have different physical origins, for example, the outer one due to solar plasma and inner one due to cosmic ray albedo decay products.

THE PRESENT STATUS OF HYPERCONJUGATION

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THE heat of hydrogenation of an olefin is appreciably decreased by the presence of alkyl substituents on the unsaturated carbon atom. This effect was explained by Mulliken, Reike and Brown¹ on the basis of a new type of conjugation²—"hyperconjugation". The resonance which results from the hyperconjugation of the alkyl group with the double bond was supposed to stabilize the molecule in the usual way and thus reduce its heat of hydrogenation. Hyperconjugation in acetonitrile or propylene, for example, would then be explained in terms of resonance between the classical structure and the *no-bonded* structure:



Although this type of first order hyperconjugation was never considered to be as important as resonance in benzene, it was expected to slightly weaken the C-H bonds and strengthen the C-C (single) bonds. A second order hyperconjugation was also considered to result from the interaction of an alkyl group with another alkyl group instead of with a multiple bond. Both molecular orbital and valence bond methods have been used to explain hyperconjugation.

A necessary consequence of hyperconjugation would be the change in the lengths of the C-H bond in the alkyl group and the C-C bond adjacent to a double or triple bond. In toluene, the increase in the C-H bond (of the methyl group) was calculated to be only 0.001 Å;¹ but the decrease in the C-Me distance has been found to be appreciable. The C-Me distance in toluene is 1.51 Å³ and in methyl acetylene⁴ and acetonitrile^{5,6} it is 1.46 Å, compared to the normal C-C distance of 1.54 Å in ethane. It was however recognized that part of these bond shortenings was due to the change in the atomic radius from tetrahedral to trigonal or digonal carbon and about one-half of the observed shortening was due to hyperconjugation.⁷

Hyperconjugation was also considered to be responsible for the dipole moment of alkyl benzenes. Toluene has a dipole moment of 0.4 D and the methyl group is positive with respect

to the benzene ring. It was therefore assumed that the electrons released by the alkyl group were delocalized which would result in a resonance stabilization of the molecule. This idea was supported by the heat of combustion of toluene which indicated toluene to be about 1.5 kcal./mole more stable than predicted by the additivity relations. Such stabilizing effects were founded in a number of hydrocarbons.^{1,8}

The ionization potentials of methylated ethylenes^{7,9,10} and the absorption spectra^{2,10-12} were also given as evidence for hyperconjugation. Alkyl substitution in unsaturated systems in general causes displacements towards longer wavelengths. However, part of these effects were considered to be due to inductive interaction.⁷

The view that C-H hyperconjugation is the prominent mode of electron release by alkyl substituents when attached to an electron demanding system was originally proposed by Baker and Nathan¹³ as an explanation of certain rate and equilibrium data. The Baker-Nathan effect was in the order Me > Et > *i*-Pr > *t*-Bu, exactly reverse of what one would expect if the electron release were by inductive mechanism.

The idea of hyperconjugation has received great attention from physical and organic chemists alike and through the years a great deal of physical and chemical evidence has been accumulated in support of this idea.^{10,14,15} However, recently there have been a number of observations which cannot be explained in a simple fashion by hyperconjugation and the situation has become controversial. In this article the author has attempted to discuss briefly the present status of hyperconjugation in the light of the more recent investigations.

Recent molecular structure investigations in several laboratories on derivatives of acetonitrile and methyl acetylene (Table I) have conclusively established that the length of a carbon-carbon single bond adjacent to a triple bond (i.e., a bond between *sp* and *sp*³ carbon atoms, designated as C-C' in Table I) is always close to 1.46 Å. It is interesting to note that the C-C' distance is not dependent on the substituents on the *sp*³ carbon, while simple electronegativity considerations would predict a variation of the C-C' bonds with substituents. The recent molecular structure determination of

TABLE I
C-C' Distances in derivatives of acetonitrile and methylacetylene

	C-C', Å		C-C', Å
Acetonitrile ^{7,6}	.. 1.46	Methyl acetylene ^{4, 16}	.. 1.46
Propionitrile ¹⁷	.. 1.47	Dimethyl acetylene ^{10, 18}	.. 1.46
Pivalonitrile ¹⁹⁻²¹	.. 1.46	Dimethyl diacetylene ^{22, 23}	.. 1.46
Trifluoroacetonitrile ^{7, 24}	.. 1.465	Methyl iodo acetylene ²⁵	.. 1.46
Trichloroacetonitrile ^{21, 20, 27}	.. 1.465	Methyl bromo acetylene ²⁵	.. 1.46
Malononitrile ²⁸	.. 1.46	Trifluoromethyl acetylene ²⁹	.. 1.46

malononitrile by Muller and Prichard²⁸ has shown that the C-C distance in this molecule is also 1.46 Å. If π -bonding caused by hyperconjugation were important, each C-C bond in malononitrile should possess considerably less double bond character than in acetonitrile. So, it is concluded that the shortenings in the C-C bonds between sp and sp^3 carbon atoms (0.08 Å) or sp^2 and sp^3 carbon atoms (0.04 Å) may not result from any kind of conjugation and that it is likely that these bond contractions are almost entirely due to the changes in the covalent radius of carbon with hybridization. In fact, the distances discussed above fit in nicely with the Hertzberg-Stoicheff^{30,31} classification of C-C distances. The bond lengths in relation to hyperconjugation have been discussed in fair detail by Sutton.³²

The evidence for hyperconjugation from calorimetric data will no longer be valid since in these calculations, the change in the bond energy of the C-C bonds with bond lengths (with hybridization) was not taken into account. It appears obvious now that the C-C bond between sp and sp^3 or sp^2 and sp^3 carbon atoms must be stronger than the normal C-C bond between two sp^3 carbon atoms). So the effects attributed to hyperconjugation of the alkyl groups are really due to the introduction of a stronger C-C bond. Since these effects have not been taken into account in the current tables of bond energies and resonance energies, the values hitherto quoted are not correct. In general, the stabilization of an unsaturated system by alkyl substitution has been found to be essentially independent of the nature of the alkyl group and cannot be accounted for in terms of steric effects. As pointed out by Turner,³³ the calorimetric results do not provide significant information on the nature of the stabilization and cannot distinguish among the various possible interpretations.

The evidence for hyperconjugation from dipole moment data also needs reinterpretation. Since the electronegativity of an sp or sp^2 carbon is different from that of an sp^3 carbon,

the resulting bonds (between any two differently hybridized carbon atoms) should have different polarity. In fact, recently Petro³⁴ has reported excellent agreement between the observed and calculated dipole moments of C-C bonds between two differently hybridized carbon atoms. Petro³⁴ concludes that hyperconjugation structures do not explain the non-zero dipole moment of toluene.

At this point, it may be worthwhile mentioning briefly a similar situation in the case of C-H bonds. The C-H bond length is dependent on the hybridization of the carbon atom.^{7,35} The magnitudes of these changes have been accounted for by a study of the charge-cloud densities in the hybrid orbitals. Since a change in the electronegativity is always associated with a change in the atomic radius, C-H bonds of different types necessarily possess different polarities. From the available structural data, it is found that carbon-halogen distances are also very markedly affected by the change in the hybridization of the carbon. A possible explanation for all these observed bond shortenings is being attempted.³⁶

The evidence for hyperconjugation on the basis of ionization potentials,^{9,10} absorption spectra,¹⁰⁻¹² and chemical reactivity^{10,13} is not foolproof because these deal with both the ground state and the excited (or transition) state of molecules. Further, the ionization potentials of the alkyl groups are found to be in the inductive order.³⁷ However, a simple molecular orbital treatment by Streitwieser and Nair³⁸ seems to indicate that the methyl group can be treated as a "heteroatom" donating two electrons to the π system. The absorption spectral evidence has met with a number of objections.^{37,39-42} Schubert and co-workers⁴¹⁻⁴³ propose an alternative explanation based on steric hindrance to solvation of the electron-deficient sites in the vicinity of the alkyl substituent. Arnold and co-workers⁴⁴ observe similar trends in the ultraviolet spectra of benzocycloalkenes and solvolysis rates of benzhydryl chlorides. The data seem to suggest the importance of

hyperconjugation and an explanation has been offered in terms of the Frank-Condon principle.

The chemical evidence for hyperconjugation has been a subject of controversy. The Baker-Nathan order, $\text{Me} > \text{Et} > i\text{-Pr} > t\text{-Bu}$, has been found in a number of reactions and has been explained in terms of C-H hyperconjugation.^{10,45-47} The importance of C-C hyperconjugation in the *t*-butyl group has also been pointed out.⁴⁸ The relative importance of C-H and C-C hyperconjugation in aliphatic and aromatic series has been evaluated by Taft and co-workers^{49,50} by application of the linear inductive energy relationship. Taft's method of evaluation of the magnitudes of hyperconjugation has been further illustrated by Baker.⁵¹ McCaulay and Lien⁴⁴ have shown that C-H hyperconjugation must be an important mode of electron release in the methyl-substituted aromatic cations. de la Mare⁵³ has discussed the possibility of OH and NH hyperconjugation. Shiner,⁵⁴ Lewis⁴⁷ and Taft and co-workers⁵⁰ have shown that hyperconjugation is one of the important sources of secondary isotope effects.

Shiner⁵⁴ considers three possible effects on hyperconjugation: steric, substituent and solvent effects. Burawoy and Spinner,⁵⁷ however, do not consider the role of solvation and suggest that electron release by the alkyl groups is only by the inductive mechanism. Schubert and co-workers,^{41,43} Baddely and Gorden⁵⁸ and Price and Blanger⁵⁹ prefer to discuss their results in terms of steric and solvent effects rather than hyperconjugation.

Berliner⁶⁰ is of the opinion that although the effect of the alkyl groups in individual reactions can be interpreted in different ways, hyperconjugation appears to be the most satisfactory general explanation for the behaviour of remote alkyl groups on the benzene ring where the Baker-Nathan order is observed.

From the discussion above it appears that any information from spectra or chemical reactivity regarding the possible role of hyperconjugation is not of much value since it is hard to distinguish such contributions in the ground state from that in the excited state of the molecule. All the physical evidence seem to rule out hyperconjugation in the ground state. These arguments have been forcefully expressed by Dewar and Schmeising,⁶¹ who have developed a new method for calculating bond lengths and resonance energies for conjugated systems taking the σ -bond compression into consideration. They argue that if the π -electron

resonance is unimportant in ordinary conjugation (as in the case of butadiene) it should be much more so in hyperconjugation. But Muller and Mulliken⁶² and Mulliken⁶³ have found it desirable to explicitly classify conjugation and hyperconjugation into two types: isovalent and sacrificial (ordinary). They suggest further classification of isovalent conjugation and isovalent hyperconjugation into three sub-types: dative, non-dative and homodative, in order of increasing conjugative stabilization. Isovalent hyperconjugation has been suggested to be more important than ordinary hyperconjugation. The Baker-Nathan effect has been described as differential hyperconjugation. Apparently there are no theoretical reasons for expecting differences between C-C and C-H hyperconjugation.⁶³

In conclusion the author feels that the present status of hyperconjugation may be summarized as follows: while the contribution from hyperconjugation seems unimportant in the ground state, it may or may not be prominent in the excited or the transition state.

The author has immensely benefited from the stimulating discussions he has had with Professors H. C. Brown, R. L. Livingston and N. Muller of Purdue University, Lafayette, Indiana, U.S.A. and Professor M. J. S. Dewar of Queen Mary College, London, England. He has taken complete advantage of the proceedings of the Conference on Hyperconjugation held at Indiana University, Bloomington, Indiana, U.S.A., in June 1958, in writing this article.

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INTERNATIONAL ATOMIC ENERGY AGENCY AS INFORMATION CENTRE FOR FUSION RESEARCH

THE Scientific Advisory Committee of the International Atomic Energy Agency which met in Vienna on 4-6 June, 1959, has made a strong recommendation that the Agency should become the world focal point for the exchange of information on progress in the field of controlled fusion and plasma physics.

The Committee advised the Director-General to initiate an international scientific journal on progress in thermonuclear fusion research. Such a journal would appear quarterly and carry technical papers on developments to all Member States engaged in such work and make the information available to the world scientific community. The Director-General was also asked to make arrangements for the convening of international scientific conferences on plasma physics and controlled fusion.

Much information in this field was made public during the Second United Nations

Scientific Conference on the Peaceful Uses of Atomic Energy, Geneva, September 1958. That Conference gave the impetus to further intensified research on fusion and developments in this sector of research are taking place rapidly in many countries. The Scientific Advisory Committee was of the opinion that it would be most useful if efforts could be directed in the most promising directions and worldwide co-operation could be initiated. The International Agency would, in the Committee's view, be the logical and most suitable agent to assume this important role.

The Seven-Member Advisory Committee includes Dr. H. J. Bhabha, Chairman of the Indian Atomic Energy Commission, Sir John Cockcroft from the United Kingdom, Prof. Emolyanov from the Soviet Union and Prof. Rabi from the United States.

ARTIFICIAL CLIMATE STATION FOR PLANT RESEARCH*

THE Artificial Climate Station of the Institute of Plant Physiology, Moscow, is so fitted that every room and every laboratory here has its own particular climate, soil, illumination and air-conditioning, thus helping scientists to study the laws governing the life of plant organisms in any part of the terrestrial globe. It is adapted for investigations to be carried on not only to ascertain the laws of growth and development of plants, but also to study their resistance to unfavourable external conditions, such as frosts, droughts, saline soils, etc.

There are special chambers at the Station for work at low temperatures. Any desired degree of cold can be produced in them, including the very lowest that exist on earth, as -80°C . Thermoregulators constantly fix the temperature within these chambers and the slightest deviation from the given conditions is eliminated automatically. These chambers also have electric stoves. When they are switched on frozen plants begin to thaw. In the cold rooms observations are made of the winter-resisting ability of plants — spring, autumn and subtropical crops, fruit cultures and forest species. Many experiments have shown that the frost-resisting ability of plants in spring and autumn is low, but that it rises in winter.

It is known that plants cannot hold out in a frost that has set in unexpectedly, say, in the middle of summer; they perish, including even such cold-resisting trees as the birch and pine. Yet during the winter they withstand frosts of -60°C . The reason for this has been investigated by the workers at the centre who are engaged in breeding frost-resisting varieties of plants.

An understanding of the nature of the very process of the freezing of a plant has proved a decisive factor in solving this riddle. It was discovered that this process begins with the formation of an icy crust on the outer cell wall. As the cooling continues, the icy crust spreads to the nourishing juices which are inside the cell, and that leads to its severance and ruin. Such is the case when there are sudden frosts in spring or summer, at a time

when the plants are in the process of growing and their cells are full of juices.

But under usual conditions the cell struggles very "cleverly" for its existence. It tries to rid itself of its water and its nourishing juices before the frosts set in. This process begins in autumn. The cells, when cooling gradually, throw off their nourishing juices into inter-cellular space, where they "winter".

The following interesting experiment was performed at the Station. Autumnal conditions were artificially created for black currant at the beginning of summer. The day was shortened, the solar light was weakened, and the temperature of the soil and air was lowered. The plant, which had not as yet borne fruit, prepared to defend itself against the frost: it dropped its yellowed leaves, and cut down on the amount of juices it consumed. Following this the plant withstood a test not only of -80°C . but even cooling to -200°C . in liquid nitrogen. Yet at the same time the berries on a control black current bush ripened.

At the Station there is a so-called "light little yard" with an extensible roof. Here during good weather, the plants are out in the open, and in bad weather they are well protected from the wind and rain. But the most interesting thing in this little yard are the thermostats beneath the roots. At first glance their designs seem rather simple. They are tanks filled with brine. Each such tank, into which 20 vegetal vessels are submerged, is automatically heated by an electric heater or cooled by a cooling apparatus. The roots of the plants which are in them are cooled or heated accordingly.

The observations that have been made have enabled the scientists definitely to establish why, for example, when the temperature of the soil is high the tubers of potatoes degenerate, whereas the lemon tree, on the contrary, greatly hastens its growth and fruiting.

As has been discovered when the temperature of the soil is high, the juice-bearing capillaries in the potato tops greatly expand, and this phenomenon is accompanied by a "feverish" rise in the metabolism of that part of the plant which is on the ground. The potato tops begin to grow luxuriantly, feeding themselves at the expense of the tubers by sucking up their juices. With the lemon, on the contrary, in

* Through the courtesy of USSR Embassy in India.

cool soil we notice "sclerosis" of the capillaries of the root system and branches of the tree. As a result of these investigations it is recom-

mended that in hot countries potatoes be planted not in spring but in summer, so that they will grow and ripen in autumn.

BACTERIA AND INSECTS: HOST-PARASITE RELATIONSHIPS

IN 1915, the German bacteriologist, Berliner, isolated from the diseased larvæ of the meal moth, *Ephestia kuhniella*, an aerobic, rod-shaped, spore-forming bacterium, which he showed to be the cause of the disease. A careful study of this bacterium, which he called *Bacillus thuringiensis*, revealed something unusual. As a culture, growing on a nutrient agar plate, became old the vegetative bacterial cells began to produce spores in the usual way; but, instead of the rest of the cell contents gradually disappearing until only the spore was left, as would normally happen with a spore-forming bacterium, a second body developed within the bacterial cell alongside the spore. What was even more surprising was that this body assumed a regular rhomboidal shape.

No one really took much notice of this structure until, in 1956, Hannay in Canada rediscovered it and proved by chemical analysis the rhomboidal granules to be protein crystals. Did these crystals play any part in the disease process?

In 1902 Japanese workers isolated an aerobic, spore-forming bacillus from diseased silkworms and called it *B. sotto*. They showed that it produced a toxin which affected the silkworms and which was associated not with young vegetative cells but with old, well sporulated, cultures. A new study of strains of *B. sotto* showed that it, too, produced protein crystals. Did these crystals have any connection with the toxin? The answer came in 1954 from Angus, also working in Canada.

Angus took an old culture of *B. sotto* and extracted it with silkworm gut juice. He then removed the spores by filtration and showed that the fluid left contained a substance which, when fed to larvæ, caused paralysis and death. The gut contents of these larvæ are very alkaline and it can easily be shown that the protein crystals go into solution in dilute alkali. Angus then separated crystal protein from spores and tried the effects of feeding and injecting various fractions.

When an old culture consisting of spores and crystals was fed to the larvæ there was first a paralysis and then the bacteria passed through

the gut wall into the body cavity to produce a septicæmia. If the same culture was injected directly into the body cavity bacteria multiplied there to give a septicæmia—but there was no paralysis. When spores alone were fed there was no invasion of the body cavity but septicæmia developed if they were injected directly into the body cavity. Crystal protein by itself caused paralysis on feeding but not on injection. It seems that: (1) Crystal protein is necessary for the penetration of the bacterium through the gut wall. (2) The protein needs to be activated by the gut juice before it becomes toxic.

Here then we have an interesting, complicated, not yet fully understood, host-parasite relationship.

B. thuringiensis, *B. sotto* and a few other bacteria producing disease in various insects are all very similar to one another and, as a group, bear a striking resemblance to a common saprophytic bacterium *B. cereus*, which abounds in soil, dust and other natural environments. The only real difference between the insect pathogens and *B. cereus* is that *B. cereus* fails to produce protein crystals and is of course incapable of causing disease.

So close is the similarity that we might well ask, "Could it be that the insect pathogens represent strains of the saprophyte which have in some way become adapted to a parasitic—and indeed pathogenic—mode of life?" This adaptation would of course involve the development of the ability to synthesise this peculiar crystalline protein. This is the crux of the whole matter. If, in the laboratory, we could take strains of the saprophyte and, by subjecting them to suitable conditions, render them pathogenic and capable of crystal synthesis we should be a big step nearer to understanding some of the mechanisms underlying the parasitic mode of life of these bacteria and to understanding the factors which led to the development of the parasitic habit. We should indeed be cultivating fields of knowledge about which we know very little.—From a paper contributed by Dr. J. R. Norris to the Glasgow Meeting of the British Association.

LETTERS TO THE EDITOR

FADING OF SHORT-WAVE RADIO SIGNALS

THIS note gives the results of some observations on the fading of radio-waves as observed at Nagpur from the stations listed in Table I. Readings were taken in the evening and during the late hours of the night. Sometimes the observations were also recorded in the morning hours and during daytime. The apparatus used for detecting the waves was a B.C. 348 Q receiver in which the A.V.C. was removed and the voltage developed across the second detector was amplified by a D.C. amplifier and measured in an A.V.O. Electronic Testmeter. The antenna used was a hollow metallic vertical rod of length 136 cm. and diameter 0.67 cm. The readings in the metre for various positions of M.V.C. were calibrated with a standard G.R. Signal Generator. The calibration curves were linear except for low and high input voltages. The error involved in taking the visual observations was less than 3% in all cases.

Sometimes the fading patterns were recorded on an Esterline-Angus Recording D.C. Milliammeter.

TABLE I
Stations and their frequencies

Station	Frequency (evening) Kc./s.	Frequency (morning) Kc./s.
Vividh Bharati Madras	.. 9735	11950.5
do. Bombay	.. 9550	11900.0
Radio Ceylon	.. 7190	9520
do.	.. 11770	15120
Radio Australia	.. 7220	..
do.	.. 9580	..
do.	.. 11710	..
Bombay	.. 7240	7240
Calcutta	.. 7210	7210
Madras	.. 4920	..
Delhi	.. 4960	..

In the case of the Vividh Bharati transmissions the fading patterns after sunset were mostly periodic on which random variations were superposed (see Fig. 1). The interval between the two successive crosses is 15 seconds. On the same wave band and at the same time for Radio Australia (9580 Kc./s.) such patterns were not observed. Further for Calcutta (7210 Kc./s.) and Bombay (7240 Kc./s.), the fading patterns after sunset were also of a quasi-periodic nature. While for Radio Ceylon

(7190 Kc./s.) in the same wave band and for Madras (4920 Kc./s.) and Delhi (4960 Kc./s.) such patterns were not so pronounced. These

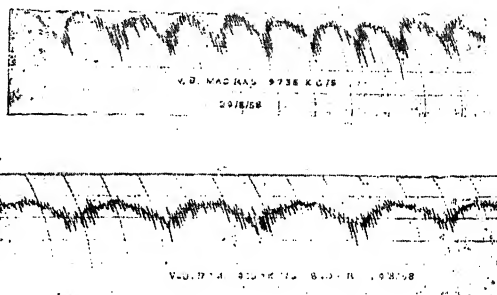


FIG. 1

patterns were not observed during the night hours.

The chief characteristics of the patterns are

- (i) The interval between the two successive maxima or minima varies from 20 to 60 seconds. The most common value is around 40 seconds.
- (ii) Their ratio changes from 1.5 to 3.0 as seen from Figs. 1 and 2.

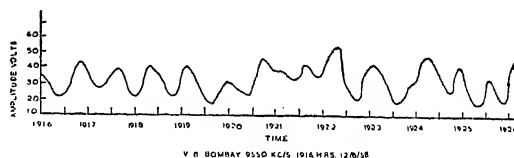


FIG. 2

Fading of radio-waves of the type recorded here is well known. Appleton and Beynon¹ have shown that periodic fading in the morning and evening hours is due to the interference between the two magneto-ionic split components (ordinary and extraordinary) of comparable amplitudes. Banerjee and Singh² also reported periodic fading patterns under conditions of high ionospheric ionisation. Khastgir and Das³ attributed this fading to Doppler beat phenomena between the two waves either singly and doubly reflected from the same layer or singly reflected from two different layers moving with the same vertical velocity. While N. V. Gurunadha Sarma⁴ has taken into account the different vertical velocities for E and F₂ layers.

The fact that such patterns are observed during the evening hours suggests that it may be in some way connected with the process in

which the F_1 layer combines with F_2 layer to form a single F layer. The special feature to be noted is that these patterns are not observed for all the stations, nor do all the stations in the same wave band give such patterns. This suggests that some relation exists between the occurrence of these patterns and the frequency of transmission, distance between the transmitter and the receiver and their location.

Most of the random looking patterns are analysed in the light of the Rayleigh Probability distribution formula for random scattering,

$$P = \frac{A}{R^2} e^{-A^2/2R^2}$$

where $P dA$ is the probability that the amplitude will lie between A and $A + dA$, R^2 is the sum of the squares of components of random phases. The procedure adopted to plot experimental and Rayleigh curves is similar to the one used by Khastgir and Ray.⁵ A small number of observations agree with this formula. Some of the curves of agreement and disagreement are shown in Figs. 3 and 4. The Rayleigh Law is

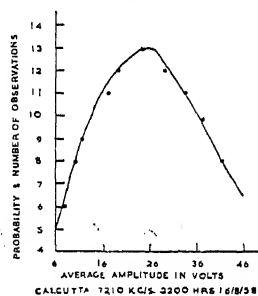


FIG. 3

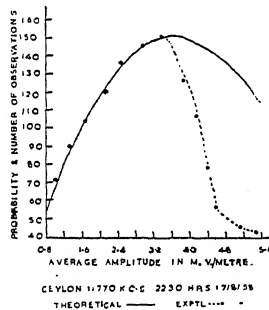


FIG. 4

valid for only one downcoming wave.

A detailed account of the above work will be published elsewhere.

The author is indebted to Prof. K. R. Dixit, for his kind interest and guidance during the progress of the work. Thanks are also due to Prof. Shahane, Dr. Kher and Shri Khandekar of the Department of Physics for their kind help during the progress of the work.

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VARIATION OF RELAXATION TIME WITH VISCOSITY—BENZYL ALCOHOL AND NITROBENZENE

RESULTS of a study of the variation of dielectric relaxation time with viscosity of the solvent in the case of two molecules, Benzyl alcohol and Nitrobenzene are reported in this article. Carbon disulphide is used as the solvent and the viscosity is varied by mixing varying amounts of medicinal paraffin. Measurements of dielectric constant and loss factor are made on a wave-guide set up at 3.20 cm. using the standing wave method of Roberts and von Hippel.¹ The method of computing the relaxation time τ and dipole moment μ is the same as the one developed by Radhakrishnamurty and Narasimha Rao.² The final results are presented in Table I.

TABLE I

Solute	Solvent	Percentage Paraffin	Solvent viscosity	Apparent $\tau \times 10^{12}$ sec.	Apparent μ D.
Benzyl alcohol ..	CS ₂ + Paraffin	0	0.34 centi-poise	7.5	1.4
		20	0.49	9.4	1.2
		40	0.78	9.5	1.2
		60	3.89	4.4	1.0
		10	0.45	7.9	4.3
Nitrobenzene ..		25	0.58	8.3	3.6
		40	0.78	9.4	4.9
		60	3.89	8.2	2.4
		88	90.00	13.1	2.2

It is interesting to note that (1) in the case of Benzyl alcohol τ goes through a maximum as the viscosity of the solvent is increased and (2) the calculated dipole moment decreases as the solvent viscosity is increased in both the cases. These may be due to the fact that the Debye equations are not valid for the higher viscosity solvents. Similar observations were reported by Whiffen and Thompson³ also.

The author wishes to express his indebtedness to Prof. K. R. Rao for suggesting the problem and for his continued interest.

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PROPAGATION OF GROUND WAVES
ACROSS A LAND/SEA BOUNDARY

With the introduction of radio aids to navigation the understanding of the directional errors introduced when the radio waves cross the land/sea or sea/land boundary became essential. Millington¹ discussed the problem of ground wave transmission across land/sea boundary and predicted that there should be a marked recovery of field strength. On medium wavelengths this recovery should extend to considerable distance over sea. Subsequently Elson² conducted experiments with 267 metre waves and his results demonstrate clearly the occurrence of recovery effect on passing from land to sea at medium wavelengths and thus confirming in general outline the prediction of Millington.¹ Our observations on the field strength of ground waves of 447.9 metres wavelength from A.I.R. Calcutta station suggest that such a recovery of field strength as expected from Millington's analysis is possible even at these wavelengths. A weak ground wave signal is received here from Calcutta which is 1370 km. away from this place, a part of this transmission path, about 650 km., being over the sea. In view of this large distance no ground wave is expected here, even after taking into consideration the relatively lower attenuation suffered by the wave over the sea path. This can be explained on the basis of Millington's theory.¹

TABLE I

Station	Distance (km.)	Wave-length (metres)	Power (K.W.)	Relative intensities	
				Theoretical	Experimental
Madras B ..	110	211.3	1	1.0	1.0
Madras A ..	110	319.1	20	17.0	19.0
Bangalore ..	205	491.8	10	10.0	8.4
Tiruchi ..	330	389.6	5	1.2	0.9
Vijayawada	340	357.1	20	2.17	1.92
Hyderabad	410	405.4	5	0.02	0.022
Calcutta A	1370	447.8	50	0.0008	0.015

In Table I are given the relative intensities of the ground waves received at Tirupati taking the intensity of the ground waves from Madras B transmitter of I.K.W. power as unity. The theoretical values of the relative intensities of the ground waves received at Tirupati from various medium wave stations are obtained from the field strength—distance curves of Terman.³ The field strength for Calcutta station has been arrived at by considering the attenuation suffered by the wave on the land and the sea-paths separately.

There is good agreement between the experimental and the theoretical values of the relative intensities for all stations excepting Calcutta. The field strength observed at Tirupati has definitely indicated a higher value than that expected. This unusual reception can be understood from a consideration of the path along which the ground waves from Calcutta reach this receiving centre. This is a case of transmission over a composite path which consists of both land and sea. Applying Millington's analysis to the case of transmission across the land/sea boundary we expect the field strength of the wave to rise above the land value at the land/sea boundary. Since the recovery which develops into a maximum extends to a considerable distance over the sea, a section of the sea-path has been traversed by the wave without suffering any alteration over the land value, but instead with a gain in field strength. The rest of the sea-path is traversed with an attenuation characteristic of the sea-water. Thus the wave reaches the sea/land boundary with a field strength which is not far lower than that at the land/sea boundary. When the waves cross the sea/land boundary there will be a rapid attenuation of the wave. On the whole sufficient intensity can be expected at Tirupati to account for the reception of these ground wave signals.

The details regarding the extent of recovery and the field strength expected here on the basis of Millington's theory are being worked out and will be published in due course.

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S.V. University, R. SATYANARAYANA.
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ORIENTED CRYSTALLISATION OF
INORGANIC SALTS ON FEATHER
KERATIN

It was reported that under certain conditions epitaxial growth of inorganic salts could be induced to take place on collagen.¹ A detailed study of the phenomenon revealed that the well known conditions controlling epitaxial growth on crystalline substrates were valid for fibrous substances also.^{2,3} The study was extended on a smaller scale to other fibrous proteins like feather, hair and silk. The experiments

conducted with feather keratin are described in this note.

Pieces of swan feather rachis were cut and washed well in distilled water. They were placed in alkaline solutions of a number of inorganic salts. The pH of the solutions was varied by dissolving different amounts of the salt in a definite volume of normal sodium hydroxide. After about 16 hours they were removed and dried. X-ray diffraction photographs of the specimens were then recorded as usual in conventional cameras using Cu K α radiation.

The action of alkali on the feather depended on the concentration. In highly alkaline solutions the substance was found to disperse while in neutral solutions no change was observed. Some of the fibres assumed a yellow tint and became somewhat soft to the touch. As a typical case the action of sodium tartrate on feather is given in Table I.

TABLE I

Specimen No.	Amount of salt	Vol. of N. Sod. hydroxide	External change of the fibre	Degree of orientation
1	(g.) 1.0	(c.c.) 5	No change	Good
2	0.75	5	Soft	Coarse powder rings
3	0.50	5	Sheath dispersed	Coarse powder rings
4	0.25	5	Transparent jelly	..
5	1.00	Neutral	No change	No deposition

The X-ray diagram recorded with specimen No. 1 exhibited extended reflexions due to sodium tartrate arranged along layer lines. In addition to these reflexions coarse powder rings of the substance were also found to occur. The

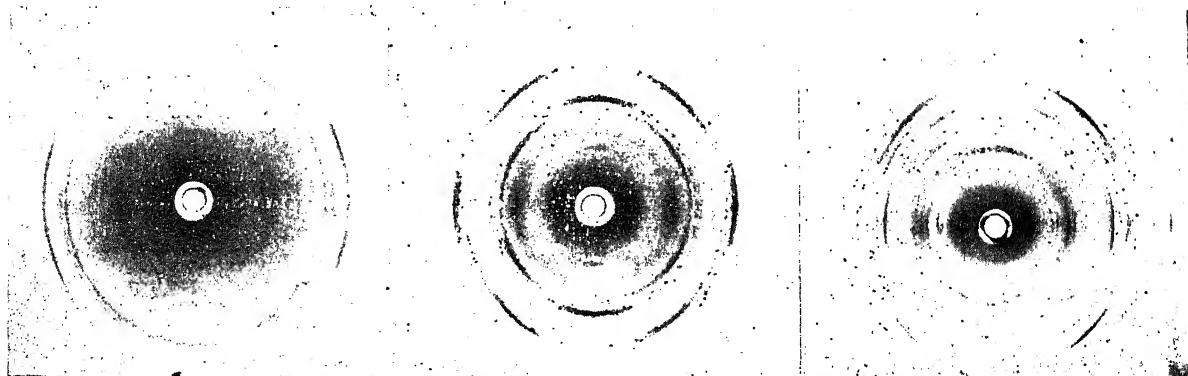
latter vanished when the surface of the specimen was scraped well with a blade. The X-ray diagram recorded with the scraped specimen in cylindrical camera (diameter 57.3 mm.) is reproduced in Fig. 1.

Similar experiments were carried out with sodium sulphate. Partially oriented deposits of sodium sulphate III was found to occur on the fibres with its *c* parameter aligned along fibre axis (Fig. 2). In one instance, the deposit was identified to be sodium carbonate monohydrate, occurring with the *b* parameter lying along fibre axis (Fig. 3). Probably this substance must have been formed in the solution by the action of atmospheric carbon dioxide on alkali. The X-ray diagrams have been recorded in a 3 cm. cylindrical camera. A number of other salts were also tried but in their case the orientation was very poor. The results are presented in Table II.

TABLE II

No.	Salt	Nature of deposits revealed by X-ray diagram
1	Sodium tartrate	.. Good orientation
2	Sodium sulphate III	.. Poor
3	Sodium carbonate, monohydrate	.. Good
4	Sodium chloride	.. Coarse powder lines
5	Sodium bicarbonate	.. No deposition
6	Potassium chloride	.. Coarse powder lines
7	Potassium sulphate	.. Powder lines due to potassium carbonate hydrate along with those of K ₂ SO ₄
8	Potassium nitrate	.. Coarse powder lines

It is interesting to note that in the case of collagen also the first three salts gave best results while orientation of potassium salts were generally poor. Recent X-ray studies conducted in this laboratory indicate that there



is considerable structural resemblance between feather keratin and collagen.⁴ The structure is believed to be a super-helix composed of triple helical ropes. In the small angle region various orders of a spacing of 95 Å occur corresponding to the 640 Å in collagen. In view of the close similarity between the molecular structure of collagen and feather keratin, it is not surprising that the phenomenon of oriented crystallisation occurs also under similar conditions in the two cases.

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Madras-25, April 29, 1959.

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AN INVESTIGATION ON THE REACTION BETWEEN BERYLLIUM SULPHATE AND OXINE

KOLTHOFF and Sandell¹ reported complete separation of aluminium from beryllium by the addition of oxine in the presence of acetic acid and ammonium acetate. Neissner² observed that complete separation of aluminium (together with iron and copper) from beryllium was possible, since, according to him, beryllium formed no complex with oxine. However, it is mentioned in the literature^{3,4} that a product of indefinite composition is obtained when a solution containing beryllium ions and oxine is made alkaline with ammonia. It, therefore, appears that no attempt has been made to determine the actual nature of the compound that is formed, if any, between beryllium and oxine. The results of this reaction by spectrophotometric method are briefly discussed here.

An aqueous solution of beryllium sulphate and an alcoholic solution of oxine were employed. Alcoholic solution of oxine was colourless and showed negligible absorption in the visible region, while the aqueous solution of oxine, prepared by means of acetic acid, was coloured yellow and showed appreciable absorption. Therefore alcoholic solution of oxine was preferred to the aqueous solution. Aqueous solution of beryllium sulphate (M/10), which was colourless and showed no absorption in the visible region, and alcoholic solution of oxine when brought together to interact in different proportions produced light yellow to greenish yellow

colour depending on the concentration of beryllium. A mixture of beryllium sulphate and excess of oxine showed maximum absorption at 410 m μ indicating thereby the formation of a complex. The composition of the complex formed was determined by Job's continuous variation method,⁵ by taking M/10 solution each of beryllium sulphate and oxine, at 450, 480, 500 and 550 m μ and the same experiment was repeated with M/20 and M/30 each of beryllium sulphate and oxine. In all the cases the maxima in the curve between optical density and concentration were obtained at the ratio 1:2 of beryllium sulphate to oxine. This ratio determines the composition of the complex and its formation may be represented by the equation, $\text{BeSO}_4 + 2\text{C}_9\text{H}_6\text{NOH} \longrightarrow \text{Be}(\text{C}_9\text{H}_6\text{NO})_2 + \text{H}_2\text{SO}_4$. That sulphuric acid is one of the products of reaction was ascertained by the pH data obtained. With the formation of the complex the pH of the solution attained a value of the order of 4.5.

The dissociation constant of the complex was determined by Job's method at 480 and 500 m μ for four different concentrations, namely, M/10 solution of beryllium sulphate with M/4, M/5, M/15, M/20 solutions of oxine. The average value of the dissociation constant K was 2.35×10^{-3} .

Detailed results of this investigation will be published later.

The authors express their grateful thanks to Prof. A. K. Bhattacharya for his kind interest in this work.

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G. S. RAO.

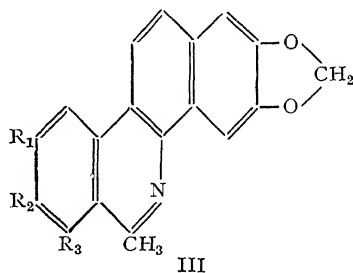
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A NOVEL DEHYDROGENATION- CYCLISATION REACTION OF 2-ARYL- 1-TETRALONE OXIME ACETATES

In connection with synthetic work on certain alkaloids of the 1:2-benzphenanthridine group, we had occasion to study the aromatisation of some substituted 2-aryl-1-tetralone oxime acetates by the Schroeter reaction. This

reaction was originally employed by Schroeter¹ for converting 1-tetralones to 1-naphthylamines. Recently Mills and Schofield² have extended this method for the conversion of 1-aryl-2-tetralones to 2-diacetylamino-1-arylnaphthalenes. In our study, 2-(3:4-dimethoxyphenyl)-, 2-(3:4-methylenedioxyphenyl)-, and 2-(3-methoxy-4:5-methylenedioxyphenyl)-1:2:3:4-tetrahydro-1-keto-6:7-methylenedioxy-naphthalenes (Ia, Ib, and Ic) were prepared by the Richardson-Robinson-Seijo method³ and converted into the respective oxime acetates (II a, II b and II c). These were then subjected to the Schroeter reaction by heating with acetic anhydride, acetic acid and hydrogen chloride in a sealed tube at 95-100°. Whereas the normal products of the reaction are the naphthylamines or their acetyl derivatives, we obtained directly in good yields the corresponding 1:2-benzphenanthridines: 6:7-dimethoxy-9-methyl-2'-3'-methylenedioxy-1:2-benzphenanthridine (III a), m.p. 233°, λ_{\max} 230, 275, 350, 365 m μ (log ϵ 4.50, 4.94, 3.67, 3.36); 9-methyl-6:7:2':3'-bismethylenedioxy-1:2-benzphenanthridine (III b), m.p. 299°, λ_{\max} 230, 275, 350, 365 m μ (log ϵ 4.35, 4.70, 3.55, 3.35); and, in the third case, a mixture of 1:2-benzphenanthridines (III c and III d) of which only one isomer, m.p. 260°, λ_{\max} 220, 280, 320, 370 m μ (log ϵ 4.31, 4.65, 4.18, 3.14), could be isolated in a pure state. The benzphenanthridines are obviously formed by the spontaneous cyclisation of the intermediate acyl derivatives under the acidic reaction condi-



- III
(a) $R_1=R_2=\text{OCH}_3$; $R_3=\text{H}$
(b) $R_1R_2=-\text{O.CH}_2.\text{O}-$; $R_3=\text{H}$
(c) $R_1=\text{OCH}_3$; $R_2R_3=-\text{O.CH}_2.\text{O}-$
(d) $R_1R_2=-\text{O.CH}_2.\text{O}-$; $R_3=\text{OCH}_3$.

tions. These represent instances of Morgan-Walls cyclisation proceeding without the use of conventional cyclisation reagents.⁴

One of us (K.W.G.) thanks the Government of India for the award of a National Research Fellowship.

Dept. of Chemistry,
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March 10, 1959.

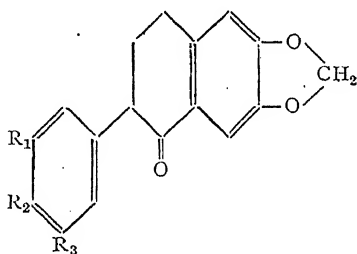
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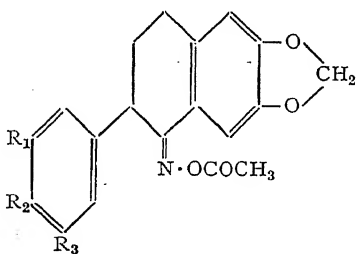
REPLACEMENT DYKES IN THE MIGMATITES OF YELLANDLAPAD

DISCUSSING the Granite-Pakhal relationship of Yellandlapad area in an earlier paper the author¹ suggested that the rocks are dominantly migmatitic with only subordinate granite and that the latter are formed due to the granitization of Pakhals in anticlinal cores. During the course of a detailed field examination of the same area, the author noticed at a few places the occurrence of quartzo-felspathic dykes and veins in very fine-grained dark looking rocks which are found as enclaves in the migmatites of the area. The dykes are exactly like the magmatic granite in appearance consisting of coarse grained white feldspars and quartz with a little mafics here and there. Their contact with the gneiss, though sharp in outline, on closer examination is found to be much wavy and irregular.

In the microscopic study, the contact between the leucocratic dyke and the host rock loses its identity. The mineralogical and textural features of the host rock, contact zone and the



I



II

dyke are clearly revealed in the photo-micrograph. The host rock is seen to consist of pseudo-cataclastic quartz and lot of greenish-brown biotite showing parallel arrangement of clusters and a good amount of oligoclase. The accessories are apatite and magnetite. All these form a ground mass in which are embedded somewhat bigger grains of plagioclase. These features of host rock persist through the contact into the dyke, the only conspicuous difference in the dyke being a decrease in the biotite content and a new development of potash feldspar porphyroblasts which include both orthoclase and microcline. While the plagioclase of the ground mass is intensely sericitized and dirty, the microcline areas are remarkably clear. The potash feldspar invariably shows corroded margins and it is no doubt growing at the expense of the ground mass as clearly observed in the photo-micrograph (Fig. 1). Myrmekitic intergrowths are

features have been reported by Goodspeed,³ King,⁴ Ramberg⁵ and others. Microscopic examination further reveals that some individual grains at the contact are common both to the dyke and host rock, and the placement of the dyke is essentially non-essential.

From these and many other observations it is concluded that the dark gneissic patches are remnants of the least granitized rock area derived from the original sediments and that the quartzofeldspathic dyke has been formed by the metasomatic replacement of the host rock with the introduction and fixation of alkalis. The marginal biotite may represent a small-scale basic front. It is also suggested that these dykes represent one of the best examples of small-scale "granitization". Further detailed work in this direction is under progress.

The author desires to express his thanks to Dr. S. Balakrishna for suggesting the problem.

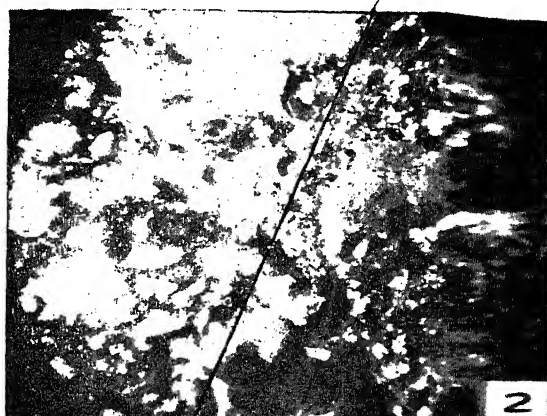
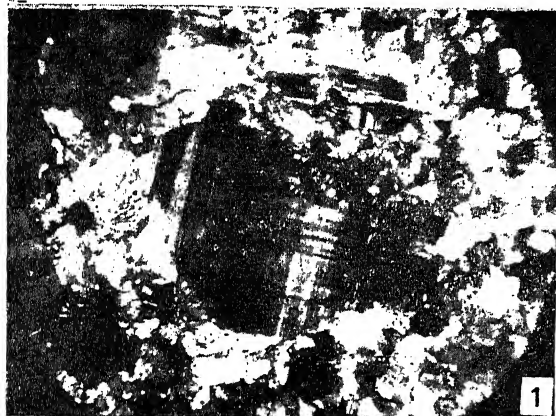


FIG. 1. GRANITE DYKE. Microcline porphyroblast with corroded margins developing at the expense of the ground mass which contains quartz, biotite, and oligoclase. Clusters of myrmekite at the contact of plagioclase and microcline. Ground mass present in the body of Microcline itself in the process of digestion.

FIG. 2. HOST-ROCK-DYKE CONTACT. Gradational contact between the gneissic host and the granite dyke. The gneiss is richer in biotite and oligoclase with fine-grained quartz. In the dyke development of K feldspars.

frequently noticed at the junction between ground mass and microcline porphyroblasts. It is noticed that myrmekite is merely a transitional stage in the conversion of plagioclase to microcline, an observation which has been recorded by Cheng² and many others in recent years. This fact is further corroborated by the presence of both myrmekite and plagioclase as inclusions in microcline in various stages of 'digestion' by potash feldspar. Another very interesting observation is that the so-called contact between the dyke and the host rock is marked by a zone of biotite enrichment, suggesting a small-scale basic front. Such

and his valuable suggestions throughout the investigation.

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**MANGANIANFLUORAPATITE FROM
HONNALI, SHIMOGA DISTRICT
(MYSORE STATE)**

CALCAREOUS manganiferous quartzites, occurring in association with limestones in the Δ 2438, North-West of Honnali, Shimoga District, Latitude $14^{\circ} 15' - 14^{\circ} 20'$; Longitude $75^{\circ} 35' - 75^{\circ} 40'$ form part of the Shimoga Schist belt of the West Central group of Dharwars of Mysore. These rocks are snuff-brown in colour, due to the coating of the manganiferous and ferruginous materials, and those that are exposed on the top of the Δ 2438 have developed good crystals of Pyrolusite. The

freshly fractured portions of the rock reveal the typical fine-grained granulitic texture of a quartzite. During the course of microscopic investigation of these rocks, it is found that quartz and calcite contain numerous minute needles of a mineral, which is identified as manganianfluorapatite on the basis of its optical and chemical characters described in this paper.

The microsections of the rock reveal fine-grained granulitic quartz and calcite, masked by ferruginous and manganiferous patches. Almost all the grains of quartz show numerous needle-like inclusions of the mineral manganianfluorapatite (Fig. 1) which shows straight extinction with negative elongation, and a faint pleochroism, which is as follows:—

X = Pale bluish green.

Z = Pale yellow or colourless. $X > Z$.

The refractive indices of the mineral determined by the Viola-Becke method,¹ are as follows:— $N_0 = 1.644$; $N_E = 1.639$; and $N_0 - N_E = 0.005$ (calculated from indices). It is found that quartz grains, separated from the rock, show the presence of needle-like inclusions (Fig. 2). The birefringence of one such inclusion, as determined by the Berek's compensator, is 0.00507, which agrees very closely with the value obtained by calculation from indices. The optical characters of the mineral, under study, are in very close conformity with those of the manganianfluorapatite, reported by Quensel² (1937).

The rough chemical composition of the mineral, as read off from the variation diagram given by Winchell for the Fluor-, hydroxyl-, and chlor-apatite system,³ is as follows:—

$$\text{Ca}_5\text{P}_3\text{O}_{12}\text{F} = 49.29\%$$

$$\text{Ca}_5\text{P}_3\text{O}_{12}\text{OH} = 39.44\%$$

$$\text{Ca}_5\text{P}_3\text{O}_{12}\text{Cl} = 11.27\%$$

When a nitric acid extract of the powder of the quartz grains, separated from the rock, was boiled with excess of lead peroxide, the solution turned distinctly violet, indicating the presence of manganese (Volhard's test).⁴ When the solution of the powder of the quartz grains, obtained by treating with hot dilute nitric acid, was filtered and when ammonium molybdate was added to the filtrate, a yellow precipitate was obtained, indicating the presence of phosphate, presumably apatite.⁵ Thus the above tests have clearly established the presence of manganese and phosphate in the mineral.

The mineral has, therefore, been identified as manganianfluorapatite.

Manganapatite has been reported from Sweden by Quensel⁶ (1937) and Mason⁷ (1941). In



FIG. 1. Calcareous quartzite showing needle-like inclusions of Manganianfluorapatite in quartz. Crossed nicols $\times 23$.

FIG. 2. Inclusions of Manganianfluorapatite in a grain of quartz, separated from the rock. Crossed nicols, $\times 90$.

India, Fermor⁸(1909) has reported its occurrence in Kodurites of Vizagapatam District. This is the first reported occurrence of the mineral in Mysore.

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THE RELATIVE IMPORTANCE OF HEREDITY AND ENVIRONMENT IN MUTTON SCORE AND FLEECE CHARACTERISTICS IN AUSTRALIAN MERINO SHEEP

ESTIMATES of heritability for fleece characteristics in Australian Merino sheep have been reported by Morley.^{1,2} Similar values for mutton type have also been recorded.^{3,4} However, no study has been made to estimate genetic correlations between fleece characteristics and mutton type. Further, as our present knowledge on the relative importance of heredity and environment in mutton type and fleece characteristics is lacking, this study was undertaken.

The flock of Peppin Merino sheep in which the observed animals were born has already been described⁵ in detail. The measured animals comprised of 269 ewe lambs born in the autumn of 1952. These animals came from seven selection groups. The number of sires used was 47.

The conditions of management were similar to those described by Morley.¹

Scoring for mutton type was done according to the procedure already mentioned.⁶ Fleece characteristics were measured by the standard methods used¹ at Trangie Agricultural Experiment Station.

Methods of analysis of variance and co-variance as proposed by Hazel *et al.*⁷ have been used. Data were analysed on sire within selection group basis. Variance between sires are probably slightly less than that in random breeding population because variance among selection

groups has been removed. The relative importance of heredity and environment is measured as per the formula already described.⁵

The mean values with standard deviations for mutton score, clean fleece weight, staple length, and crimp per inch were 4.59 ± 2.33 , 7.36 ± 0.94 (lb.), 9.84 ± 0.87 (cm.), and 10.15 ± 1.98 , respectively.

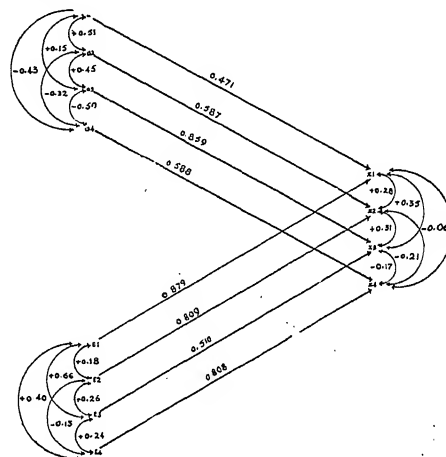


FIG. 1. Path coefficient diagram illustrating the Genetic (G), Environmental (E) and Phenotypic (X) relations between mutton score and fleece characteristics. Suffixes 1, 2, 3 and 4 represent mutton score, clean fleece weight, staple length and crimp per inch, respectively.

Figure 1 is a graphical presentation of the results obtained and sets out genetic and environmental factors causing variation in the observed phenotypic values. The path coefficients, represented by straight lines, indicate the quantitative importance of each source in causing variation. The direct influence of the cause to the effect is shown by the arrows while the relation between each source is represented by correlation coefficients. These are shown by curved double-headed arrows.

The path coefficient is defined as "the ratio of the standard deviation of the effect when all causes are constant except the one in question, the variability of which is kept unchanged, to the total standard deviation". Each path is therefore calculated by dividing the square root of the variance for a given source by the square root of the phenotypic variance. As heritability is the ratio of the additive genetic variance to the total phenotypic variance, in this case, it can be directly calculated by squaring the individual path coefficient.

The following points of interest emerge from Fig. 1 :—

(a) *Phenotypic correlations.*—(i) There is no significant correlation between mutton score and

crimp per inch although mutton score is positively correlated (significant) with each of staple length and clean fleece weight; (ii) clean fleece weight has a positively significant correlation with staple length although its association with crimp per inch is negatively significant; and (iii) there is a negative (significant) correlation between staple length and crimp per inch.

(b) *Genetic correlations*.—(i) Mutton score is positively correlated with each of clean fleece weight and staple length although it has a negative correlation with crimp per inch; (ii) clean fleece weight is positively correlated with staple length and negatively correlated with crimp per inch; and (iii) there is a negative correlation between staple length and crimp per inch.

(c) *Environmental correlations*.—(i) Mutton score and clean fleece weight have a positive environmental correlation; (ii) clean fleece weight and crimp per inch have significantly negative correlation; and (iii) the remaining correlations are all positively significant.

(d) The heritability estimates (square of path coefficients) for mutton score, clean fleece weight, staple length, and crimp per inch are 22, 34, 74 and 35%, respectively. Environment, therefore, plays greater part in causing variations in mutton score, staple length, and crimp per inch than does heredity.

Genetic and phenotypic correlations amongst the fleece characteristics confirm the earlier findings^{1,2} in Australian Merino sheep. However, the association of mutton score with fleece characteristics is being reported here for the first time. Our results suggest that selection for mutton type in this breed will increase the staple length and the clean fleece weight but there will be, however, an appreciable decline in crimp per inch.

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October 10, 1958.

BIOLUMINESCENCE IN VISAKHA- PATNAM HARBOUR

EMISSION of light or bioluminescence has been independently developed in diverse groups of animals and it is interesting to note that this phenomenon is almost exclusively confined to marine organisms. Among the Protozoa the Radiolarians and Dinoflagellates are the only groups representing bioluminescent forms. Harvey¹ has given an excellent account of all luminous organisms reported up to 1952.

Except for the report of a luminescent Radiolarian *Thalassicolla* sp.² off the Andaman Islands, in the Bay of Bengal, and some bioluminescent animals in the Gangetic delta,³ published information on bioluminescence in the coastal waters around India is very scanty, even though many casual reports have been made without tracing the light emission to any particular organism or group of organisms.

While making routine plankton collections after dusk in the local harbour we observed on the night of 7th November 1958, intense emission of bluish-white light when the water in the Southern Lighter Channel leading to the Turning Basin was disturbed. When the sample of plankton was kept undisturbed in a dark room in the laboratory numerous rapidly moving luminescent sparkles were observed. Microscopic examination of the sample showed that the plankton contained swarms of the dinoflagellate *Peridinium granii* Ostenfeld⁴ together with a few Diatoms, Copepods and Rotifers. By isolating the Peridinians and keeping them in Whatman-42-filtered seawater it was confirmed that the luminescence was due to these organisms. The water in the Channel continued to be luminescent for the next two days and thereafter the Peridinians dwindled in numbers rapidly with a corresponding fading and final disappearance of the luminescence after about a week.

To observe whether there is a day and night rhythm in the production of light by these organisms, the plankton samples were kept in finger-bowls in a dark room and observations were made at regular 3-hour intervals after the eyes were thoroughly dark-adapted. The emission of light started at dusk and became intense towards midnight and finally faded at the approach of dawn. Similar day and night rhythms have previously been reported among other Peridinians also.

When the samples were fixed by the addition of formalin there was continuous emission of light for 15 to 20 seconds until the organisms were killed.

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Attempts are being made to culture these Peridinians for further observations.

We are thankful to Sri. D. V. Subba Rao for identifying the Peridinium.

This work has been carried out with the funds provided by the Forest Research Institute obtained from various sources for the execution of the Scheme on "Protection of Timber against Marine Organisms Attack".

Department of Zoology, P. N. GANAPATI.
Andhra University, D. G. V. PRASADA RAO.
Waltair, M. V. LAKSHMANA RAO.
March 13, 1959.

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ON THE STRUCTURAL AND FUNCTIONAL DIFFERENCES BETWEEN THE ANTERIOR AND POSTERIOR TESTIS IN THE CATFISH, *MYSTUS SEENGHALA* (SYKES)

KERR⁵ has stated that the sperm duct of *Polypterus* "is not, except near its termination, a simple tube but contains a network of cavities continuous with those of the testis. It is in fact not a simple duct but a portion of the testis which has become sterile". Jungerson (cited by Kerr⁵) recorded a homologous condition of the posterior testis in the young teleosts.

A detailed study of the seasonal histological changes occurring in the testis of *M. seenghala* reveals that while its anterior three-fourths is functional, the posterior one-fourth is sterile. The marked seasonal changes are restricted to the functional part only. This species breeds once a year. As in the case of many teleosts^{1,7,8} the testis has a characteristic period of rest, activation, growth, maturity and depletion. The period of active spawning of *M. seenghala* is from March to May in the river Ganges at Banaras. A rise in the water temperature appears to be one of the chief factors influencing spawning as in the case of the Perch,⁸ *Gasterosteus aculeatus*,¹ *Fundulus heteroclitus*,⁶ *Galeichthys felis*,² *Lepomis macrochirus*³ and *Huro salmoides*.³

Figures 1 and 2 represent the structure of the anterior and posterior testis during its resting

phase. In the anterior testis the lumen of the lobule is more or less completely displaced by the spermatogonia and each lobule looks like a cord of germ cells (Fig. 1).

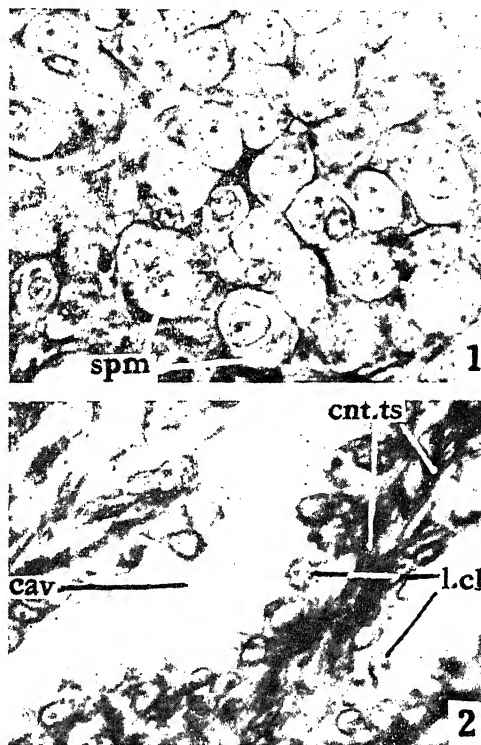


FIG. 1. Showing the structure of the anterior testis during the resting phase, $\times 450$.

FIG. 2. Showing the structure of the posterior sterile part during the resting phase, $\times 700$.

Bouin and Haematoxylin-Eosin.

cav.—cavity, cnt.ts.—connective tissue, l.cl.—lining cell, spm.—spermatogonia.

In the 'transitional zone' between the functional and sterile regions, the spermatogonia are seen towards the outer margin, which numerically dwindle and disappear in the posterior part.

The sterile part is formed of a network of cavities which is lined by small cells (Fig. 2). These cavities may represent the lobules and the lining cells, the degenerate spermatogonia. The cells do not show any seasonal variation. During the spawning phase the cavities are distended with sperms and establish connection with the sperm duct which is situated on the inner margin of the testis. Further behind, the sperm ducts on either side unite to open into the common urinogenital papilla. In the depleted testis the cavities are prominent with scattered sperms. But during the accompanying resting phase they collapse, and a quantitative

increase in the connective tissue elements lying in between is evident (Fig. 2).

Thus the structure of the posterior testis of *M. seenghala* may be interpreted as the retention of a juvenile teleostean⁵ feature which is comparable to the condition prevailing in *Polypterus*.⁵

The details of the gonadal cycle are being communicated for publication elsewhere.

Department of Zoology, A. G. SATHYANESAN.
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DIFFERENTIAL RESPONSE TO POTASH APPLICATION IN THE SWEET POTATO (*IPOMOEA BATATAS*)

WITH a view to ascertaining the role of variety in the uptake of potash in the sweet potato, a preliminary trial was undertaken during 1957-58 with eight varieties and two levels of K_2O (0 and 100 lb. per acre as sulphate of potash). The results of this trial are reported here.

The varieties used in the trial were Yellow Jersey (USA), F.A. 17-White (China), White Star (USA), Batan Appu (Ceylon), Gwalior Red (M.P.), Gwalior White (M.P.), Coimbatore Local (Madras) and Rani (Mysore). They were chosen at random from the genetic stocks maintained at the Station for breeding work. They were planted on 6-11-1957 in two replications, each comprising five rows of 35 sets. The fertilizer was applied in furrows at the time of planting. The trial was harvested on 15-4-1958. The data on yield are given in Table I.

From Table I it would be clear that sweet potato varieties used in the trial gave a marked differential response to potash application. Further investigations are in progress.

It is not common that different varieties of a crop plant respond differently to a given level of a fertilizer. Ahlgren and Sprague (1940) found that varieties of white clover (*Trifolium repens*) differed in their response to mineral fertilizers. In maize (*Zea mays*) inbred lines and the F_1 hybrids frequently show differential

TABLE I

Showing the effect of potash application on the yield of eight varieties of the sweet potato

Sl. No.	Variety	Mean yield per acre (calculated) in Md.		Per cent. increase in yield of K_1 over K_0 plots
		K_0	K_1	
1	Gwalior White	45.05	54.19	20.20
2	Gwalior Red	70.88	97.66	37.50
3	Batan Appu	59.86	82.86	38.40
4	Yellow Jersey	47.26	96.41	104.00
5	F.A. 17 White	53.56	127.60	138.20
6	White Star	36.86	90.42	145.30
7	Coimbatore Local	21.74	67.74	211.30
8	Rani	10.40	41.59	300.00

response to various nutrients including phosphorus and nitrogen (1955). In the potato (*Solanum tuberosum*) foreign varieties like Up-to-Date, Craig's Defiance, Furore and Voran showed a higher response to potash than the local varieties, *Phulwa* and *Darjeeling Red Round* in trials, conducted at this Institute (1957).

Our thanks are due to Dr. Pushkarnath, Director of the Institute, for his keen interest in the work.

K. N. CHHIBBER.

M. J. DESHMUKH.

Central Potato Research Institute,
Regional Research Station,
Patna, May 5, 1958.

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USE OF POLYTHENE BAGS TO SECURE HIGH INFECTION BY *TOLYPOSPORIUM PENICILLARIAE* BREF. IN *PENNISETUM TYPHOIDES* STAPP. AND HUBBARD

WHILE surveying the incidence of smut disease of bajri (*Pennisetum typhoides* Stapf. and Hubbard) in Gujarat it was observed that in Kutch the smut infection was as high as 5%, presumably, due to the practice of irrigating the bajri fields at the time of flowering and the disease was absent in Saurashtra where the practice of irrigating the bajri fields is not followed. While testing the virulence of various isolates and resistance of several varieties of

bajri against smut, at the Institute of Agriculture, Anand, it was experienced that humidity higher than 90% was essential to secure high infection by artificial inoculation.

The usual practice of covering the inoculated earheads with butter paper bags for protection against aerial infection was found unsatisfactory for production of high infection under normal field conditions with humidity 90% or below.

The butter paper bags were, therefore, replaced by polythene bags with an idea that the water of transpiration may be retained to provide enough humidity for penetration and infection by the smut fungus.

In the month of August 1958, when there was long period of drought and humidity much below 90%, the earheads in boot-stage¹ were inoculated with sporidia. Such earheads were then covered with polythene bags of 10" × 3½". At the same time several such inoculated earheads were also covered with butter paper bags (Fig. 1). Ten days after inoculation of the

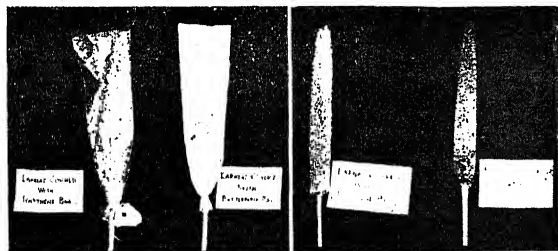


FIG. 1. Retention of water of transpiration in the form of film and drops in polythene bag.

FIG. 2. Huge number of sori in place of grains when covered with polythene bag. Sori are comparatively bigger than grains.

earheads the observations on infected earheads and number of sori present on them were obtained as recorded in Table I.

TABLE I

Type of bags used	No. of earheads covered after inoculation	No. of earheads infected	Per cent. disease	Mean no. of sori per earhead
Polythene ..	175	118	67.58	63.00
Butter paper	35	0	0.00	0.00

The results in Table I show that the infection was more than satisfactory where the earheads were covered with polythene bags whereas there was no infection on the earheads covered with butter paper bags (Fig. 2).

It seems that the water of transpiration which was accumulated in the polythene bags (Fig. 1) provided almost 100% humidity which helped in germination of sporidia, and penetration and infection by the pathogen into the host tissue. The humidity, under butter paper bags, was at par with field condition (about 80%) which was not suitable for infection by smut fungus. Consequently, there might have been 100% failure of infection by the pathogen.

The use of polythene bags described here for securing high infection by smut fungus in bajri is considerably superior to the butter paper bags. Furthermore, polythene bags are reusable several times.

Dept. of Plant Pathology, M. H. PATEL.
Institute of Agriculture, M. V. DESAI.
Anand, September 30, 1958.

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SOME PARASITES OF SUGARCANE SCALE *ASPIDIOTUS* (TARGIONIA) *GLOMERATUS* GREEN

NARAYANAN and Rao¹ have recorded two parasites, namely, *Anabrolepis mayurai* (Encyrtidae) and *Azotus delhiensis* Lal (Eulophidae) from the sugarcane scale, *Aspidiotus glomeratus*. The author, while studying the biology of this scale insect at Sugarcane Breeding Institute, Coimbatore, encountered four different species of parasites; three belonging to the family Encyrtidae, viz., *Xanthoencyrtus fullawayi* Timb.; *Microterys* sp. and *Anabrolepis bifasciata* Ishii and one to the family Eulophidae, namely, *Azotus chionaspidis* How.

Among the four parasites mentioned above, *X. fullawayi* Timb. has been reported as a parasite of *Trionymus insularis* Ehrhorn and *Saccharicoccus sacchari*² from Hawaii. *Microterys* sp. and *A. chionaspidis* How. have been found mostly as parasite of different species of Coccids in several countries. These parasites were found only in small numbers and seemed to be of little consequence for the control of the scale insect. However, *A. bifasciata* Ishii was observed to prevail on a much larger scale. In Japan, Tachikawa³ found it as a parasite of *Ceroplastes rubens* Marshall.

An examination of the scale-infested canes at this Institute revealed that the parasitisation was as high as 10-15% during May-June and again in September-October, when several

hundreds of parasites could be collected from even a single stalk. The large-scale emergence of parasites evidently shows *A. bifasciata* to be of a great potential utility for biological control against this sugarcane scale.

The author is thankful to Dr. N. R. Bhat, Director, Sugarcane Breeding Institute, Coimbatore, for the interest shown during the course of these studies. Grateful thanks are also due to the Head of Insect Identification and Parasite Introduction Section of the United States Department of Agriculture, for kindly identifying the insects.

R. A. AGARWAL.

Sugarcane Breeding Institute,
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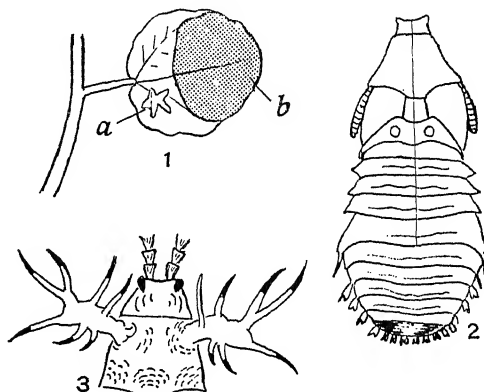
ON THE OCCURRENCE OF *HISPA* *PALLESCENS* GUERIN.

THE larvæ of *Hispa pallescens* were found forming blotch mines on the leaves of *Triumpheta rotundifolia* and *Abutilon* sp. during November 1956 at Dhadesugur. This appears to be the first record of this somewhat rare insect species in Mysore State.

The Mines.—The newly hatched grubs form small asteronomes (star-shaped mines). They come out of the primary mine after 48 to 60 hours and produce fresh, full depth, roundish, secondary blotch mines with wavy margins. Black frass in a mass is deposited irregularly, mainly at the centre of the mine. The mines on *Abutilon* sp. are characteristically milky to opaque white, whereas they are deep brown, almost entirely covering the leafamina on *Triumpheta*. In the former host the grubs eat the whole mesophyll between the two epidermal layers and the mines therefore appear transparent when held against light. Part of the spongy paranchyma along with the lower epidermal layers are left intact on *Triumpheta*, which renders the mine hardly visible on the lower surface of leaves. The blotches are 2 to 2.8 cm. in diameter and only one larva feeds in each mine. Fresh linear mines are formed before pupation so that the full grown larvæ are just accommodated inside for pupation. It was observed that the full grown larva produces about 6 mm. length of mines in 2 to 2½ hours.

STAGE AND LIFE-HISTORY

Egg.—White, flattish oval, inserted singly inside the leaf tissue; incubation period 3 to 4 days.



Hispa pallescens Guerin.

FIG. 1 a. Primary Mine, b. Secondary Mine on *Triumpheta rotundifolia*.

FIG. 2. Pupa. FIG. 3. Head and Prothorax showing Spines

Larva.—Milky white, with prominent, brown mandibles; head square and retracted in the broad prothorax which is brown and strongly chitinised; antennæ three-segmented, minutely hairy; abdominal segments broadening till 5th A, bear thin pointed spinules; 5th A the broadest bears brown, robust spines protruding at sides; lateral pads on 6th to 10th A are soft, broad and serrated; anal segment is thinly chitinised with two spinules. All the abdominal segments have transverse depressions on dorsal surface. Full grown larvæ measure 5 mm. long and 2.25 mm. broad at 5th A. The larval period is 10 to 12 days.

Pupa.—Pupa is active, mobile; light brown turning deep brown before emergence of adult. Prothorax is very large, four times the size of the head; broader (1.20 mm.) than long (0.83 mm.). Posterior end has a dorsal transverse depression. Metathorax has two black protruding knobs. 5th A, the broadest, has long out-growing spines on lateral sides; 6th A to 10th A are rounded up with semicircular posterior end. A 6, 7 and 8 possess twin spinules. 9th and 10th A fused, bearing two large pads having five serrations each. Pupal period lasts for six to eight days. The pupa falls out of the mine before emergence of the adult beetle, through posterior end.

Adult.—Rather sluggish, hardly moves if disturbed. At rest, legs are folded in, antennæ held together straight ahead setting close to the leaf. The beetles scrape the green chloro-

phyll, in short irregular arcs, copulating couples being seen from August to September. In captivity they live without food up to seven days. In nature the adults are mostly found hiding on the undersurfaces of the lower leaves. The general activity of the insect species was not observed from February to June, being hot months. The adult has been described by G. Maulik.¹

The adult is 3.9 to 4.1 mm. long and 2 mm. broad. Out of the 6 species belonging to the genus *Hispa* (by Maulik¹) *Hispa pallescens* only is brown in colour, all the remaining being black.

I am greatly indebted to Dr. Hall, of Commonwealth Institute of Entomology, London, for the identification of the insect species.

Dhadesugur,
October 24, 1958.

S. N. KADAPA.

1. Maulik, *Fauna of British India, Chrysomellidae, Hispina and Cassidina*. 4, 254.

OCCURRENCE OF STERILITY IN *PHASEOLUS MUNGO* (*UDID*)

Phaseolus mungo, popularly known as *Udid*, belongs to subfamily Papilionatæ under natural order Leguminosæ. *Udid* flower is a typical Papilionaceous flower having standard petal, overlapping the wing and keel petals, andræcium and gynæcium. Normally anthers dehisce, prior to opening of flowers. At the time of anthesis

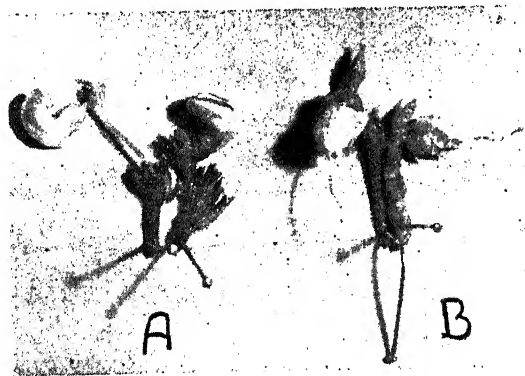


FIG. 1. (A) Normal flowers, (B) Sterile flowers.

anther-sacs are quite close to the stigma and the structure enclosed by keel petal. This mechanism secures self-pollination.

During the course of observation in the breeding material of *Udid*, at the Agricultural Research Station, Jalgaon (East Khandesh), the authors observed some sterile plants in the variety

Idgaon 2-3. In appearance, the plants were alike but in sterile plants, pod-setting did not occur. On closer observation the flowers showed some deviation from the natural ones. The style was found elongated and protruding beyond the corolla. This elongation of style was noticed prior to opening of flowers and even earlier than anthesis (Fig. 1 B). Stamens were of normal size. Pollen grains showed normal appearance to iodine staining.

The sterility therefore is due to hercogamous condition, preventing self-pollination. Natural cross-pollination is normally negligible in *Phaseolus mungo*. These conditions account for lack of pod-setting in these plants.

This appears to be the first report of sterility in *Udid*. Further work regarding maintaining sterility by sib-mating and crossing it with desirable types of *Udid* for study of mode of inheritance of this character is in progress.

Agricultural Research Station, M. M. GHARE.
Jalgaon (East Khandesh), J. S. THAKARE.
November 12, 1958. P. D. PATIL.

SYSTEMIC ACTION OF CERTAIN ORGANOPHOSPHOROUS INSECTICIDES

STUDIES for systemic action were pursued under pot culture conditions by the author with reference to *Parathion*-(Diethyl-paranitrophenylthiophosphate), *Systox* (Diethoxythiophosphoric ester of 2 ethyl mercapto ethanol) and *Pestox-3H*-(Bisdimethyl amino phosphorus anhydride). The results obtained are presented in this note.

Six weeks old healthy cowpea plants were treated with the above-mentioned formulations. In one set of trials, the spray fluid was applied to the soil at the base of the plants, while in the other the same was used as a direct foliar spray at 0.15% concentration. The next day after treatment, twenty wingless adults of the aphid-*Aphis medicagenis* K. of uniform age drawn from the aphid culture maintained in the laboratory were introduced over each of the treated plants and covered over with a wire gauze cage. Colonisation of a similar number of aphids was continued for a fortnight. Counts of the surviving population were recorded everyday at 9 a.m. over a period of 30 days. The experiments were replicated four times, maintaining an untreated check for comparison.

Due to the intake of the poisoned sap, a characteristic restlessness was observed in the behaviour of the aphids, introduced on the plants treated with *Pestox* and *Systox* at 0.15% concentration, either as a soil application or as a direct foliar spray. These wandered from

place to place on the plant and ultimately dropped down dead in about twelve hours. The percentage of mortality was cent per cent. in the course of twenty-four hours under both the formulations. The toxicity of the plant was maintained for the first ten days following the insecticidal treatment. Subsequent to this the introduced aphids were able to thrive and gradually the percentage of mortality declined. No such results were noted in the case of plants treated with Parathion, and the colonised aphids began to establish themselves as in the control. It is, therefore, evident that Parathion is not absorbed in sufficient quantities to render the sap toxic. The present study also confirms that the active principle of Systox and Pestox 3H gains an entry into the cell sap, both through the medium of the root system as well as by contact with the aerial parts of the plant.

A detailed account of the above investigations will be published elsewhere.

Entomological Division, K. R. NAGARAJA RAO.
Agricultural Research Institute,
Coimbatore-3, December 12, 1958.

TWO NEW SPECIES OF *DISCOSIA* FROM BOMBAY

THE fungus genus *Discosia* is represented by only two species in India, viz., *Discosia himalayensis* Died. and *Discosia tenzingii* Lacy. (1946, 1958). Saccardo (1931) records 19 species of this genus. Besides the fungus genus has not been previously reported from Bombay State. The species were, therefore, studied in detail and are presented here as new to science with Latin diagnosis on the basis of comparative morphology and host relationship.

1. *Discosia hiptages* TILAK sp. nov.

Pycnidia nigra, dispersa, amphigena, discoidea, immersa in textus plantæ hospitis, magnit. $119-89 \pm 102-56 \mu$. Conidiophori bulbosi, breves. Conidia hyalina, 2-3 septata, cylindrica, fastigata ad utrumque apicem, tenuiter curvata, $25-34 \pm 2-3.5 \mu$, una appendice ad utrumque apicem ornata. Lectus in foliis viventibus *Hiptages bengalensis* Kurz. mensibus julio et augusto ad Poona in India anni 1958 a S. T. Tilak.

2. *Discosia bombycina* VISWANATHAN sp. nov.

Pycnidia fusce brunnea, amphigena, dispersa, globularia, immersa in textus plantæ hospitis, $118-202 \mu$ diam., ostiolate, ostiolo magnit. $30-50 \mu$. Conidiophori bulbosi, breves. Conidia hyalina, vulgo 4-cellulata, cylindrica, tenuiter curvata, magnit. $31-40 \pm 2.5-4 \mu$, ornata una

appendice filiformi, hyaline, ad utrumque apicem magnit. $3.5-7.8 \mu$.

Typus lectus in foliis viventibus *Syzygium cumini* Skeel ad Poona in India die 15 Julii anni 1958 a T. S. Viswanathan.

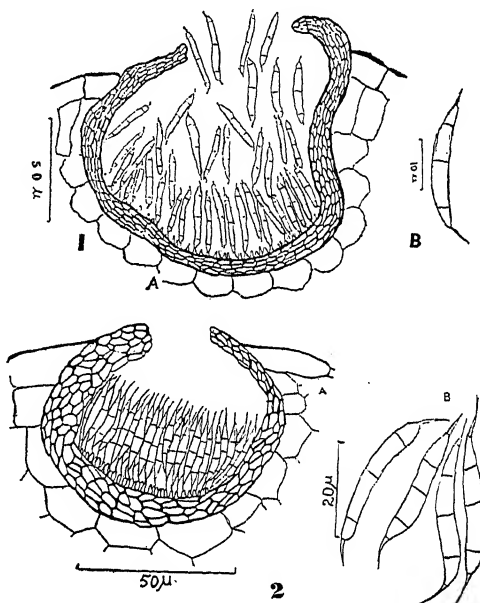


FIG. 1. *Discosia hiptages*. (A) Section through pycnidium, (B) Conidium.

FIG. 2. *Discosia bombycina*. (A) Section through pycnidium, (B) Conidia.

It may be noted that while the two previously described Indian species of *Discosia* were collected at very high altitudes, the present collections were made at comparatively low altitudes of about 1800 ft. The genus is also a new record for Bombay fungi.

The type specimens have been deposited in Herbarium Cryptogamæ Indiæ Orientalia, New Delhi, India and Herbarium of the Commonwealth Mycological Institute, Kew, England.

The authors are very grateful to Prof. M. N. Kamat for guidance, to Dr. S. P. Agharkar, Director, for laboratory facilities and to Rev. Father H. Santapau for Latin diagnosis.

M.A.C.S. Laboratory, S. T. TILAK.
Law College Buildings, T. S. VISWANATHAN.
Poona-4,
December 31, 1958.

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MEIOTIC STUDIES IN *CROTALARIA* *SERICEA* RETZ. AND THE BASIC NUMBER IN THE GENUS *CROTALARIA*

CYTOLOGICAL investigation in the genus *Crotalaria* was started in India by Ramanujam *et al.*¹ in 1933. They determined the chromosome number in some four species of this genus and found $n=8$. Later workers have reported $2n=16$ or 32 ,² except in one species *Crotalaria incana* in which somatic number has been reported to be 14 .³ Dutta (1933),⁴ however, reported 10 as the haploid number in the genus *Crotalaria*. There is thus no unanimity about the basic chromosome number in this genus although the majority of the workers reported it to be 8.

Instead of investigating the cultivated or the previously studied species of the genus it was planned to study wild species growing in nature in different localities. *Crotalaria sericea* is one such species which is found growing wild at different places near about Patna and investigation in this species has, therefore, been made. For the sake of cytological studies anthers were squashed to study meiosis in the PMCs. Acetocarmine squash gave quite satisfactory preparation. In anthers, the division in the PMCs was not synchronous. Quite a high percentage of cells showed normal metaphase and anaphase but about 5% of PMCs displayed some meiotic irregularities. In most of the nuclei studied at diakinesis, one bivalent, unlike others, took the

shape of a ring. This ring-like bivalent appeared to be quite characteristic. At late metaphase seven of the bivalents separate normally (Fig. 1) and reach the two poles but one of the bivalents remains as a laggard for quite a long time. At late first anaphase when the seven chromosomes at the poles are about to enter telophase the lagging bivalent separates and the two complements pass towards the two poles but remain far behind the pole and are presumably excluded (Fig. 2) or both may be included in one telophase nucleus. This lagging bivalent was found in quite a number of PMCs and in every case they showed the above-mentioned behaviour. It is evident from the above description that in the population of *Crotalaria sericea* Retz. in which the gametic number was determined as 8^5 there are PMCs with regular meiotic divisions giving rise to normal gametes with 8 chromosomes and also PMCs in which irregular behaviour of a bivalent may give rise to gametes with 7 or 9 chromosome numbers. The question about the basic chromosome number can therefore be finally decided when a large number of plants in the genus are cytologically investigated. Studies in this direction are being continued.

Department of Botany,

Patna University,

Patna, November 25, 1958.

R. P. ROY.

R. P. SINHA.

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PRELIMINARY REPORT OF THE FOSSIL LEAF-IMPRESSIONS FROM MEWAR STATE

IN 1955 Murty reported the occurrence in Mewar State of a Tertiary limestone containing gastropods and "abundant Dicot—and Monocot—leaf-impressions". There are two localities of this limestone "one at the tenth milestone on the Udaipur-Gogunda Road and the second about six furlongs west-north-west of the first occurrence". From the second locality Dr. Mrs. Chitale collected a few specimens of the leaf-impressions in December 1956 while on an excursion with the students.

The specimens are incomplete impressions of leaves showing good details of venation. There

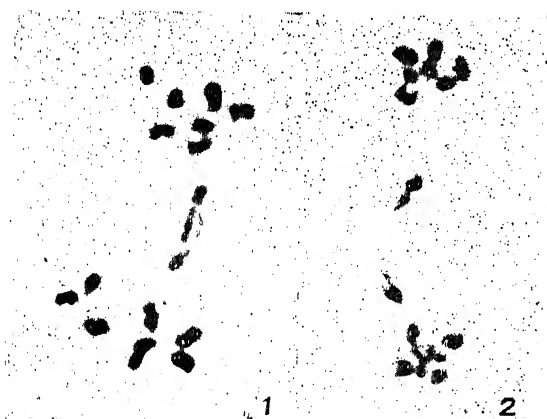


FIG. 1. Photomicrograph of a pollen mother cell of *Crotalaria sericea* Retz. showing early anaphase in which a ring bivalent is still at the equator, $\times 1,500$.

FIG. 2. Photomicrograph of a pollen mother cell of the same species showing late anaphase in which the complements of the lagging bivalent have separated but have a tendency to be either excluded from the telophase nuclei or both to be included in only one nucleus.

are six of them which have been selected for detailed examination. For the present they have been numbered as A, B, C, D, E and F. Of these A and B seem to be similar. So far

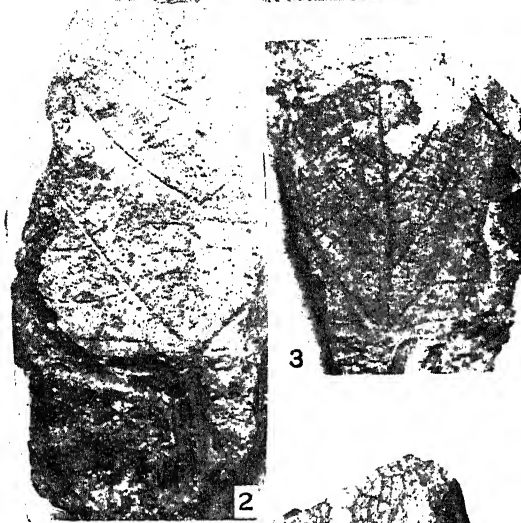
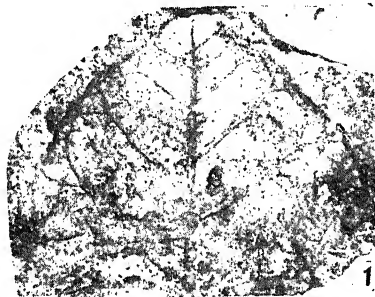


FIG. 1. Impression of an upper half portion of a Dicotyledonous leaf (A) showing crenate margin.

FIG. 2. A fossil Dicotyledonous leaf (F) with petiole.

FIG. 3. Almost a complete impression of a small leaf (E).

FIG. 4. Impression of a fragment of a large leaf (D) showing distinctly the curved midrib, lateral veins, and reticulum.

it has not been possible to identify the specimens with the modern plants and their investigation is in progress. However, four of them are figured here to show their general structure and venation. In all the specimens the leaves are simple and dicotyledonous showing unicostate, reticulate venation.

The author is grateful to Dr. Mrs. S. Chitaley for giving the necessary guidance in this work.

Botany Department,

MRS. T. TRIVEDI.

College of Science,

Nagpur, December 3, 1958.

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CONTROL OF MANGO MALFORMATION DISEASE

A DISEASE affecting the mango inflorescence, turning it into malformed leafy witches brooms, was reported from Poona by the author.¹ The diseased panicles were found to be parasitised within the tissue by a species of *Eriophyes*. These microscopic mites are both inter- and intra-cellular, inciting cell enlargement and rapid multiplication of undifferentiated type of tissue. The mites can be located in any part of the meristematic tissue of the malformed spikes during the flowering season. After the drying up of the diseased panicles, the mites can be located within the tissues of the axillary buds of shoots from which new inflorescences are formed in the succeeding year.

Observations carried out during the last four years to evaluate the role of the mites in the incitement of the disease have given very interesting data. Fifty infected trees which were fairly well separated in distance were marked, and the counts were made for the number of infected inflorescences. In 20 trees which on an average had 28 to 30 malformed inflorescences, the diseased shoots were excised up to one to two feet behind the inflorescence. All these were carefully collected and burnt. The other 30 trees, where the diseased shoots remained as such, served as controls.

Observations have indicated that in the trees where the diseased shoots were excised, there was reduction in the number of diseased inflorescence in the very next year, the average being 8 to 10 per tree. The systematic removal of the diseased inflorescence, for four consecutive years, has resulted in 15 of the trees being completely free from infection and the other 5 showing only one or two malformed

spikelets. In the controls, the percentage of infection remained same or increased according to the number of flowering shoots borne. In some trees all the shoots were diseased. In some instances healthy inflorescences were produced in shoots which had malformed spikelets in the previous season. The systematic eradication of infected shoots having resulted in the disappearance of the disease it has become apparent that the disease is incited by the mites. The concept of virus as being the causal agent of mango inflorescence malformation is negatived.

Pimpri, M. J. NARASIMHAN.
Poona,
May 21, 1959.

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ON THE OCCURRENCE OF NOSTOCHOPSIS LOBATUS IN ASSAM

Nostochopsis was described with the type species *N. lobatus* by Wood¹ in 1869. Two other species have also been described, *N. hansgirgii* by Schmidle (1900) and *N. radians* by Bharadwaja (1934). From India *N. lobatus* was collected by Prof. Iyengar from near top-slips in the Annamalais and from a stream in Tirumoorthy hills near Coimbatore. Desikachary² has studied these materials in detail. *N. hansgirgii* had been recorded as growing on rocks in a rivulet near Goregaon, Bombay, by Dixit (1936). *N. radians* was collected from Jog Falls, Mysore, by Bharadwaja³ and by Prof. Iyengar, so also by Venkataraman from Tenmalai, Kerala (Personal communication). Thus, so far, the species of *Nostochopsis* seem to have been described from south of India only. The alga of present record was collected from Basishtasramam (7 miles from Gauhati town), Assam. The alga was growing on rocks in a stream of the locality and was collected more than once during the months of December-February.

The species agree to the type description of *N. lobatus*, in having a hollow thallus, filaments entangled with true branching, filaments 3-8 μ in breadth at the region of branching, intercalary (rare) and lateral (pedicellate and sessile) heterocysts. The occurrence of the alga is reported as it is a new record from the North-Eastern parts of India.

Thanks are due to Prof. H. K. Baruah, for his kind encouragement, to Mr. S. N. Barua for the fresh material recently collected by

him and to Mr. G. S. Venkataraman for helping with some literature.

Botany Department, P. R. MAHADEVAN.
Gauhati University, Assam,
March 4, 1959.

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MERMIS SP. (MERMITHIDAE, ASCARIDEA, NEMATODA) AND ITS INSECT HOSTS

MANY kinds of insects are parasitised¹⁻⁷ by nematodes, particularly of the family Mermithidae, which are of considerable economic importance.

Our breeding records show that the following species of insects have been parasitised in nature by *Mermis* sp. (probably *indica*) in Dehra Dun (unless otherwise indicated).

These data indicate that these worms have a very wide range of hosts. Their attack is mainly confined to the larvæ of Lepidoptera and rarely the larvæ of leaf-eating beetles, e.g., *Calopepla leayana* Latr. (Coleoptera) and the adult grasshoppers (Orthoptera), are infested. All these nematodes were in an immature stage and belong to *Mermis* sp. (probably *indica*). The parasite worm comes out forcing its way through the body-wall between the segments. About half an hour or more is often required for complete emergence. In some cases, the worm, when about half way out from the host, coils round itself in such a form that its extrication becomes easy. The host either dies immediately at the time of emergence or leads a lingering existence for a short time.

These mermithids are usually long, slender worms which feed by the absorption of the body fluid and complete only part of their larval development in the body cavity of the host. Only one worm was found in each host, except in two insects, viz., a larva of *Epiplema* sp. defoliating *Gmelina arborea* and a pyralid larva feeding on *Stereospermum* sp., harbouring two and three worms respectively. Exact larval period is not known, but in one case the worm came out from the host after 17 days. Further development of the premature, free-living worm is unknown. Two freshly emerged worms were kept on 10th July 1936 (Expt. No. 651A) in a pot having damp soil. They remained alive for 68 days. The soil was kept moist by sprinkling water when necessary.

TABLE I

Host insect parasitised		Food plant of host	Season
ORDFR : LEPIDOPTERA			
Epiplemidæ			
<i>Epiplema</i> sp.	..	<i>Gmelina arborea</i>	September
Eucosmidæ			
<i>Argyroplote cellifera</i> Meyr.	..	<i>Eugenia jambolana</i>	do.
Geometridæ			
<i>Hyposidra successaria</i> Wlk.	..	do.	August
Unidentified Geometrid	..	<i>Litsea polyantha</i>	September
Hyblæidæ			
<i>Hyblæa puera</i> Cram.	..	<i>Tectona grandis</i>	August, September and October
Noctuidæ			
<i>Anomis fulvida</i> Guen.	..	<i>Kydia calycina</i>	August
<i>Brithys crini</i> Fabr.	..	Lily	January
<i>Eutelia favillatrix</i> Wlk.	..	<i>Lamnea grandis</i>	October
Notodontidæ			
<i>Neopheosia excurvata</i> Hamps.	..	<i>Anogeissus latifolia</i>	July ; in Sillari, Nagpur-Wardha, M.P.
Pieridæ			
<i>Pieris brassicae</i> Linn.	..	..	December
Psychidæ	..	<i>Shorea robusta</i>	October
Pyalidæ			
<i>Hapalia machæralis</i> Wlk.	..	<i>Tectona grandis</i>	July and September (Also in Rohatgaon, Hoshangabad, M.P.)
<i>Hysipyla robusta</i> Moore.	..	<i>Cedrela toona</i>	July and October; in Top Slip, Nilambur (Madras)
<i>Lamida nubilalis</i> Hmps.	..	<i>Garuga pinnata</i>	October
<i>Margaronia hilaralis</i> Wlk.	..	<i>Anthocephalus cadamba</i>	September
<i>M. pyralis</i> Wlk.	..	<i>Morus alba</i>	July to October
<i>Sylepta talteata</i> Fabr.	..	<i>Bursera serrata</i>	August
<i>Tyspanodes linealis</i> Moore	..	<i>Salmalia malabarica</i>	September
Unidentified pyralids	..	<i>Mallotus philippinensis</i>	August
		<i>Shorea robusta</i>	July
		<i>Stereospermum</i> sp.	September
Sphingidæ			
<i>Deilephila nerii</i> Linn.	..	<i>Tabernaemontana coronaria</i>	November
ORDER : COLEOPTERA			
Chrysomelidæ			
<i>Calopepla leayana</i> Latr.	..	<i>Gmelina arborea</i>	August
ORDER : ORTHOPTERA			
Acrididæ			
Unidentified grasshopper	..	<i>Prunus persica</i>	September

These emergence records indicate that rainy season and winter are the normal time for the emergence of these worms. The parasite moves about slowly if the soil is wet. On a dry soil, it coils itself into a compact roll and drying is fatal. The length of these worms varies, extending from 5 to 24 cm.

Forest Research Institute, R. N. MATHUR.
Dehra Dun, November 21, 1958.

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**STURMIA (S. STR.) FLAVOHALTERATA
BISCH. (TACHINIDAE: DIPTERA)
ON PRECIS ORITHYA SWINH.
FEEDING ON STRIGA SP.**

EARLY in 1949, the writer and his co-workers had recorded the occurrence of *Precis orithya* Swinh. (Lepidoptera : Nymphalidæ) on *Striga*—the phanerogamic root parasite of Sugarcane (*Saccharum officinarum*) and Jowar (*Sorghum vulgare*) crops in the Nizamasaagar area (former) Hyderabad State. Since then observations have been continued by the writer on the evaluation of the efficacy of this insect in the biological control of *Striga*. *P. orithya* occurs also in many other parts of India and in 1953, Agarwala and Naquvi² made observations on its biology and carried out feeding tests in Bihar State and recorded the occurrence

rence of an unidentified tachinid parasite on this insect.

During the course of investigations in Hyderabad State, one of the limiting factors observed in the natural multiplication of this insect, was the occurrence of the tachinid parasite *Sturmia* (s. str.) *flavohalterata* Bisch. The occurrence of this parasite is a new record for India, its former host records being *Amphicallia bellatrix* and *A. thelwalli* (Lepidoptera: Arctiidae) feeding on Mlanja Cedar in Nyasaland.³

Seasonal history studies were carried out by periodical collections of caterpillars from a wide area and rearing them in the laboratory. The following table gives the percentage of incidence of *S. flavohalterata* during October, November and December, 1954 and 1955.

TABLE I

Locality	Percentage of incidence					
	1954			1955		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
1 Rudroor and Akbarnagar	4.5	15.0	30.5	12.0	8.5	..
2 Varni ..	2.5	20.0	52.5	..	15.0	20.5
3 Bodhan ..	..	2.5	10.5	5.0	12.5	12.5

The larval stages of the fly are as usual entirely endoparasitic and only one maggot is found in each affected host larva; mostly early to middle instar caterpillars are found attacked. The full grown maggot makes an incision in the ventral area of the host abdomen and emerges; pupation is outside the body of the host probably in the soil. The pupal period ranges from 4-6 days. The adult flies, when fed with dilute honey in the laboratory, live 3-5 days.

The writer's thanks are due to the authorities of the Commonwealth Institute of Entomology, London, for the identification of the parasite. The study reported herein was carried out under the guidance of Dr. M. Q. Khan, Entomologist to the Hyderabad State Government, to whom the writer is indebted for facilities provided and encouragement given.

Entomological Section, D. V. MURTHY.*
Department of Agriculture,
Hyderabad (Dn.), January 7, 1959.

* Present Address: Section of Entomology, Department of Agriculture, Bangalore.

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COMPARATIVE EFFECTS OF POTASSIUM AND COBALT IN AN EARLY VARIETY OF RICE

It is well known that potassium^{1,4} and cobalt^{2,3} play significant roles in the growth and metabolism of plants. The effects of potassium and cobalt in an early variety of rice are reported in this note.

Graded seeds of an early variety of rice, N. 136, were soaked separately in the concentrations of 1, 10, 100 and 1,000 p.p.m. of potassium chloride and cobalt chloride. After 48 hours of soaking, the seeds were washed thoroughly in water and sown in earthenware pots. The plants were then separated into two different series; Series I was left after the initial soaking without any further treatment, while Series II was given in addition a regular foliar spray once a week with the corresponding solution in which the seeds were initially soaked. The spraying was commenced with 3-weeks old seedlings and was continued until panicle emergence. A third set of seeds soaked in distilled water served as controls.

The average days taken from sowing to ear emergence under different treatments are presented in Table I.

TABLE I

Effect of potassium chloride and cobalt chloride on time from sowing to ear emergence in the main shoot (Average of 16 plants)

Sowing date: January 17, 1958

Treatments	Days from sowing to ear emergence			Earliness (+) or delay (-) in days from control
	Seed soaking (Series I)	Seed soaking plus spray (Series II)	Mean per treatment	
KCl	1 p.p.m. ..	70.25	70.75	70.50 +1.28
	10 p.p.m. ..	69.56	69.81	69.68 +2.10
	100 p.p.m. ..	68.06	67.87	67.96 +3.82
	1,000 p.p.m. ..	65.31	68.06	66.68 +5.10
	Control ..	71.50	72.06	71.78 ..
CoCl ₂	1 p.p.m. ..	73.19	74.31	73.75 -0.50
	10 p.p.m. ..	74.69	75.06	74.88 -1.63
	100 p.p.m. ..	74.94	75.56	75.25 -2.00
	1,000 p.p.m. ..	75.50	75.87	75.69 -2.44
	Control ..	73.06	73.44	73.25 ..

In KCl series, S.E. Mean for chemical effect=0.21 and C.D. at 5% =0.61.

In CoCl₂ series, S.E. Mean for chemical effect=0.30 and C.D. at 5% =0.86.

A study of Table I shows that potassium chloride induced an earlier ear emergence in the treated plants. The earliness gradually

TABLE II

Effect of potassium chloride and cobalt chloride on the production of tillers and leaves and on plant height (Average of 16 plants in each series)

Treatments	No. of tillers per plant				No. of green leaves per plant				Height per plant in cm.			
	Potassium		Cobalt		Potassium		Cobalt		Potassium		Cobalt	
	As % of control		As % of control		As % of control		As % of control		As % of control		As % of control	
1 p.p.m. ..	5.64	109.30	5.38	92.28	24.64	110.25	20.55	93.07	49.86	104.90	50.07	89.97
10 p.p.m. ..	5.84	113.18	5.09	87.31	25.94	116.06	19.72	89.31	51.18	107.68	43.11	86.45
100 p.p.m. ..	6.41	124.22	4.72	80.96	27.97	125.15	18.39	83.29	53.27	112.08	47.13	84.69
1000 p.p.m. ..	7.92	153.49	4.46	76.50	34.12	152.66	17.31	78.39	55.05	115.82	45.24	81.29
Control ..	5.16	100.00	5.83	100.00	22.35	100.00	22.08	100.00	47.53	100.00	55.65	100.00

increased from 1 day with the lowest concentration of 1 p.p.m. up to 5 days in the highest concentration of 1,000 p.p.m. Cobalt chloride, on the other hand, brought about a delay in ear emergence, significant results being obtained in the higher concentrations of 100 and 1,000 p.p.m.

Observations on morphological characters such as number of tillers, total number of green leaves, and height of the plants as influenced by the various concentrations of the two inorganic solutions were made several times during the life-cycle and the mean values of all the observations of both the series considered together are presented in Table II.

The results in Table II show that potassium chloride in general brought about a better vegetative growth whereas cobalt chloride brought about a depression in these aspects.

Our thanks are due to Sri. M. P. Jha, Statistician, Central Rice Research Institute, Cuttack, for help in statistical analysis.

Department of Botany, G. MISRA.
Ravenshaw College, Cuttack-3, D. MISHRA.
November 24, 1958.

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GERMINATION OF POLLEN GRAINS OF VITIS VINIFERA

For hybridizing grapes (*Vitis vinifera* L.) successfully under Saharanpur conditions, it was considered desirable to find out a suitable culture media for testing the germinability of its pollen grains. Ziegler and Branscheidt¹ obtained maximum pollen germination with European grapes in 2½% sucrose solution at 29° C., whereas Gollmick² used a mixture of 5% sucrose and 2% agar in a moist chamber at 26° C.

In the present study, fresh pollen grains were collected from two high pollen yielding varieties—Large white and Black cornichon of *Vitis vinifera* L. during March 1958. They were planted in cavity slides containing varying concentrations of sucrose solution and distilled water. These slides were kept in moist petri dishes at room temperature and were examined every ten minutes under the microscope. The maximum length of the pollen tube was measured with the help of standardized ocular micrometer and data are summarized in Table I.

TABLE I

Sl. No.	Media used	Pollen grain	
		% germination	Maximum tubelength (in μ) in 6 hours
1	Distilled water ..	5.7	16.2
2	2% Sucrose solution ..	7.5	29.4
3	5% " ..	10.2	61.8
4	8% " ..	12.6	114.8
5	11% " ..	15.3	132.5
6	15% " ..	36.8	162.0
7	20% " ..	56.6	390.3
8	25% " ..	70.4	491.9
9	30% " ..	45.1	58.9
10	35% " ..	40.2	14.7

It is seen from Table I that maximum pollen germination and tube growth was obtained in 25% sucrose solution under Saharanpur conditions. The viability of the grape pollen can, therefore, be successfully tested in 25% sucrose solution.

Horticultural Research Institute, S. N. SINGH.
Saharanpur,
January 19, 1959.

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REVIEWS

Organic Syntheses with Isotopes. By Arthur Murray III and D. L. Williams. Part II—Organic Compounds labelled with Isotopes of the Halogens, Hydrogen, Nitrogen, Oxygen, Phosphorus and Sulphur. (Interscience Publishers, Inc., New York and Interscience Publishers Ltd., London), 1958 Edition. Pp. 1146-2096. Price \$ 25.00.

A review of the First Volume of this work appeared recently in *Current Science* (Vol. 28, 1959. Pp. 42-43). The general features of the work were there set out in detail. It is, therefore, not necessary to traverse the same ground again here.

It is not surprising that deuterium compounds occupy a substantial part of the present volume, covering 400 pages. Nitrogen-15 comes next with 150 pages and then Sulphur-35 with 80 pages and iodine with 64 pages. The remaining 170 pages are divided pretty equally between the other isotopes considered, namely, Bromine, Chlorine, Oxygen-18 and Phosphorus-32. Two isotopes of iodine figure in the volume, viz., Iodine-128 and Iodine-131, the latter much more prominently. Two isotopes of Bromine appear, viz., Bromine-80 and Bromine-82 and three isotopes of Chlorine, viz., Chlorine-34, Chlorine-36 and Chlorine-38.

The present volume contains the General Index for both the volumes and is therefore indispensable to a possessor of the first volume. All chemical names are indexed, with the sole exception of common solvents. Page numbers are presented in three modifications: Complete syntheses of compounds are indicated in bold-face type, references to preparations without procedural details are given in italics, and the use of compounds as reagents is shown by entries in ordinary type. Index forms of text names are constructed, where feasible, according to the Subject Index usage of *Chemical Abstracts*. Order is primarily based on non-isotopic parts of names. Secondary considerations, in decreasing order of importance, are element symbol, superscript, subscript and locant.

The second volume, like the first, is clearly an indispensable possession for every organic chemistry library.

C. V. R.

The Sources of Invention. By John Jewkes, David Sawers and Richard Stillerman. (MacMillan & Co., Ltd., London), 1958. Pp. xii + 428. Price 31 sh. 6 d.

Collection of facts and circumstances which led to discoveries helps to trace the growth and development of science during a given period. In this book are presented a great body of data which led to the development of science in the past century.

Part I deals with the background and the successful attempts of scientists to place their inventions at the disposal of technologists. It also points out the difficulties that individual inventor had encountered and how these were overcome by research corporations and the team-work of scientists, towards the development of organised research. The peculiarity of this century appears to lie in the relative decline of invention of the individual type in certain industries with large research laboratories attached to them. A crucial distinction has been made in this book, in purposes, methods and results between pure science and technology. Science is directed towards understanding, and technology is directed towards use. Another point made out is that history of invention shows no sharp break in continuity. In Part II the author has presented case histories of certain important inventions made during the past century. All these cases can be held to belong to the twentieth century, the year 1900, that is to say, has been taken as the dividing line between old and modern inventions. Special mention should however be made of case histories of Cyclotron, Helicopter, Jet engine, Radar, Magnetic recording, Radio and Rockets. A complete and connected account of each of these inventions has been given in a very interesting manner.

This book would be a valuable addition to any scientific library. S. BALAKRISHNA.

The Theory and Design of Magnetic Amplifiers. By E. H. Frost-Smith. (Chapman & Hall Ltd., London; India: Asia Publishing House, Bombay-1), 1958. Pp. 487. Price 75 s. net.

This book provides an excellent treatment of saturable reactors (magnetic amplifiers) for power frequencies and frequencies somewhat higher.

The section on commercial applications could have been considerably expanded, and a much more complete biography than is contained in the rather meagre references would have been helpful. For example, many papers on magnetic amplifiers have been published in the last few years in such journals as *Communications & Electronics* (a publication of the American Institute of Electrical Engineers), few of which are mentioned in this book.

However, the treatment of many phases of magnetic amplifiers is exhaustive. This reviewer found Chapter 13 on *Construction and Design of Magnetic Amplifiers* especially helpful. The portion of that chapter on *Design Procedure* contains much material not generally found in other books on the subject.

A serious omission is the complete absence of any material on the newer uses of magnetic amplifiers, such as their use as audio-frequency amplifiers in public address systems¹ and for radio-frequency amplification and computer applications.²

Ferrites³ receive almost no notice although they have made possible the use of magnetic amplifiers for a whole new field of frequencies.⁴ The treatment of a large new array of magnetic alloys should have been expanded, possibly with the incorporation of tables giving the comparative characteristics of these materials.⁵

Nevertheless, this is one of the best books on the subject to appear recently, and any user of magnetic amplifiers in the lower frequency field will find the book very useful.

P. H. C.

1. A paper by J. J. Suozze and E. T. Hopper in *Communications and Electronics*, pp. 297-301, July, 1955.
2. Catalog sheets of Potter Instrument Co., Inc., Great Neck, New York.
3. *New Developments in Ferromagnetic Materials* (a book), by J. L. Snoek. (Elsevier Press, Houston, Texas), as a typical example.
4. *Magnetic Amplifiers: Theory and Applications* (a book), by Sidney Platt (Prentice-Hall, New York), pp. 204-05.
5. *Magnetic Amplifiers* (a book), by H. F. Storm (John Wiley & Sons, New York), pp. 30-31.

Practical Invertebrate Anatomy. Second Edition.

By W. S. Bullough. (MacMillan & Co., Ltd.), 1958. Pp. v + 483. Price 30 s. net.

In writing this book Prof. Bullough has provided the advanced student of Zoology with a helpful addition to his library. This second revised edition has been prepared as a result of the current theory of the origin and evolution of Metazoa.

Hitherto the Coelenterata were considered to be the most primitive Metazoa but now the researches of Govan Hadzi make it necessary for us to accept that Turbellaria Acoela are indeed more primitive and plausibly evolved from the multinuclear Protozoa. Hence the author examines the Platyhelminthes before the coelentrates and within the coelentrata the Actinozoa are considered as the most primitive class.

The book offers descriptions of 122 commonly studied genera. The happy combinations of details of classification, accounts of the distribution, habitat and mode of life of the genus, and notes on the significance of unusual organs or structures, make the book a *vade mecum* of practical invertebrate anatomy.

References to more detailed descriptions are made available wherever possible and appendices are skillfully introduced to give culture, killing, fixing, and staining methods. A generous supply of semidiagrammatic and well labelled figures aids in the understanding of anatomical descriptions. And, as a finishing touch, Prof. Bullough provides us, in his final appendix, with details of the composition of the fixatives, stains and other solutions which he has mentioned in the course of the text.

Considering that the book will probably be put to constant use by students, the publishers have provided a firm cover. The book is essential for any well equipped Zoology library.

B. R. S.

Perspectives in Marine Biology. By A. A. Buzzati-Traverso. (University of California Press, Berkeley; Cambridge University Press, London N.W. 1), 1958. Pp. xvi + 621. Price 75 sh.

This publication includes forty-two papers presented at a symposium held in 1956 at the Scripps Institution of Oceanography to discuss the future bearings in marine biology.

The rapid advances in biology during recent years have been achieved through the application of experimental methods and also the techniques and concepts of other scientific disciplines. But all this work has been almost exclusively on non-marine organisms. At present, only morphology and taxonomy are concerned with the totality of animal forms, while experimental studies of evolution, genetics and biochemical investigations are restricted to a few groups of non-marine organisms. Can such a procedure give us a balanced knowledge of biology as a whole? Will it not be fruitful

if we extend the experimental, biochemical and other approaches to marine organisms also. The papers and discussions in the book under review are all focussed on this problem of experimental approach and on discovering new horizons in marine biology.

In the course of the symposium several illuminating ideas and suggestive possibilities have been brought forward, a few of which may be mentioned. (1) Ernest Baldwin emphasises the need for comparative biochemistry of poikilotherms, especially those dwelling in transitional habitats, and for the establishment of marine biological stations devoted primarily to biochemical studies of living organisms. (2) S. S. Kohn links dairy research at Reading to investigations on the source of vitamin A in whales, and wants that research vessels should roam the seven seas and bring back organisms not for enshrining them in formalin but for the investigation of their dynamical biochemistry. (3) Szent-Gyorgyi with characteristic perspicacity suggests that we should develop a quantum-mechanical biology. (4) E. M. Rae suggests that for experimental ecology we should establish a school of plankton husbandry, and that we should try to discover the marine equivalents of the guinea-pig, mouse and fruit-fly for experimental work in marine biology. (5) It is also emphasised that the prime factors in the determination of marine populations are not the gross chemical and physical parameters, but the less obvious factors like vitamins, metabolites, etc., in sea-water. (6) Prof. Hardy points out that we cannot regard marine ecology as exact until we can with reasonable frequency apply to it the crucial test of prediction. (7) Television techniques can be used for selective sampling of deep bottoms, plankton studies and ecological surveys. (8) The behaviour of pelagic organisms may in part be determined by polarised light. In the wealth and variety of marine invertebrates we have very valuable material for genetical, cytogenetical and evolutionary studies.

It will be seen that this book under review is a signpost in marine biology indicating forthcoming developments in marine biology, which will have far-reaching effects on biology as a whole, and confer on it a 'sea change into something rich and strange'. Buzzati-Traverso, the moving spirit behind the symposium, has ably edited this book, which deserves a careful study by all those interested in the biology of tomorrow.

R. V. SESHAIYA.

Annals of the New York Academy of Sciences.

Screening Procedures for Experimental Cancer Chemotherapy. By C. Chester Stock and others. (Vol. 76, Art. 3), 1958. Pp. 409-970. Price \$ 5.00.

Lymphocytes and Plasmacytes in Nucleoprotein Metabolism. By Margaret A. Kelsall and Edward D. Crabb. (Vol. 72, Art. 9), 1958. Pp. 293-338.

Psoriasis. (Vol. 73, Art. 5), 1958. Pp. 911-1037.

The first monograph, the outcome of the joint efforts of the Cancer Chemotherapy National Center, U.S.A., and the New York Academy of Sciences, constitutes a comprehensive review of the state of knowledge in the field of anti-cancer screening.

Part I of the monograph exhaustively discusses the application of bacterial, fungal and protozoal bioassay methods. The studies on a series of 200 compounds, utilizing 16 microbiological systems have led Foley to conclude that these assay systems are highly useful for routine screening programmes. Exploratory aspects of the use of drug resistant microorganisms, the usefulness of the mutagenicity test as a simple preliminary screening procedure and of lactic acid bacteria for evaluation of purine and pyrimidine antagonists, highlight the special microbiological systems presented.

Tissue culture techniques have naturally attracted attention as useful tools for characterization of nutritional requirements, metabolic activity and morphologic changes of malignant cells. Recent developments in the field, as applicable to screening procedures have been outlined in Part II of the monograph. The tumorigenic activity of tissue cell cultures, comparison of biological qualities of 'transformed' cells of normal and cancerous origin; tumour-specific cyto-toxicity of antitumour agents and highly informative discussion on the variability of results obtained on different cell systems are the main features presented in the second part.

Ascites tumours have been used to a considerable extent in chemotherapy studies of cancer. They constitute a peculiar '*in vivo-in vitro*' test. Part III of the monograph discusses limitations of the technique, parameters of ascites tumour growth, the action of mitotic poisons on hyperdiploid Ehrlich mouse, ascites carcinoma, sensitivity of solid and ascites forms of sarcoma 180 and Ehrlich carcinoma, evaluation against Nelson ascites tumour and screening techniques with ascites hepatoma.

It is not possible to review in this brief account the extremely informative chapters on Lymphomas, Hormone responsive tumours, the human tumour in heterologous hosts, etc. Consultation of the original papers in the volume is sure to benefit all research workers in this field of cancer chemotherapy.

Antibody production, protein synthesis and transport of nucleoproteins to the sites of growth and repair are problems which have attracted the attention of research workers of different disciplines. The second monograph, though small in size, has comprehensively reviewed all available information for and against the tenet that lymphocytes and plasmacytes are primarily true trephocytes that synthesize and store nucleoproteins. The development turnover and fate of the circulating lymphocytes, the origin of plasmacytes, the normal and pathological distribution of these cellular elements in the body, and the significance of the interposition of lymph nodes, spleen and intestinal lymphoid tissue in the circulatory system, as presented, leaves no doubt of their important role in nucleoprotein synthesis, storage and transport. The significance of the presence of lymphocytes and the formation of plasmacytes in wound healing, inflammation, tumour growth and the effect of their depletion on repair, growth, and immunity have been very well discussed. Biochemists, pathologists and clinicians will find in this small volume a highly informative presentation.

In spite of the advances in medical research Psoriasis still remains "the great dermatological mystery". Etiological factors are still indeterminate, while clinical morphology of Psoriasis continues to rest on solid foundation, characterizing the disease as an entity. A detailed study of the pathology and histochemistry has not shed light on any specificity of the disease process.

Though no spectacular therapeutic success has yet been obtained, the steady untiring attempts of histopathologists, chemists, biochemists and clinicians are paving the way for a rational understanding of the disease. This monograph presents the results of these investigations. Comprehensive review on the histochemistry of Psoriasis by Braun Falco, application of electrophoresis to the diagnosis of psoriasis, chemical and biochemical changes in psoriasis and the significance of the enzymatic alterations in the psoriatic scales are some of the interesting chapters in this volume. Observations on the problem of pathogenesis

suggesting psoriasis as a pathological acceleration of epidermopoiesis and clinical experiences with an allantoin coal-tar preparation will be found useful by physicians in general and dermatologists in particular.

M. SIRSI.

Books Received

- Studies on the Structure and Development of Vertebrates*, Vols. I & II. By Edwin S. Goodrich. (Dover Publications, New York), 1959. Chapters 1-8 & 9-14. Pp. 1-485 & 486-837. Price \$2.50 each Volume.
- The Atom and its Energy*. By A. D. Gupta. (Asia Publishing House Bombay-1), 1959. Pp. vi + 140. Price Rs. 9-50.
- Some Aspects of Multivariate Analysis*. By S. N. Roy. (Asia Publishing House, Bombay-1). Pp. vi + 214. Price Rs. 18-00.
- Technical Communication 26; Horticulture in the British Commonwealth, an Outline*. By D. Akenherd. (Commonwealth Agricultural Bureaux), 1958. Pp. vii + 63. Price 10 sh.
- The Magneto-Ionic Theory and its Applications to the Ionosphere*. By J. A. Ratcliffe. (Cambridge University Press, London N.W. 1), 1959. Pp. x + 206. Price 40 sh.
- Liquid Helium*. By K. R. Atkins. (Cambridge University Press, London N.W. 1), 1959. Pp. x + 312. Price 60 sh.
- National Physical Laboratory Symposium No. 8—Visual Problems of Colour (Vol. I) and the Needs and Prospects of Subjective Colour Measurement (Vol. II)*. By W. D. Wright. (Her Majesty's Stationary Office, London), 1959. Pp. viii + 749. Price £2-2-0.
- Rape and Mustard*. By Dharampal Singh. (The Secretary, Indian Central Oilseeds Committee, Hyderabad-1 Dn.), 1958. Pp. viii + 105. Price Rs. 8-00.
- An Introduction to Organic Chemistry*. By V. N. Deshpande. (Book Centre, Hubli), 1958. Pp. 232. Price Rs. 4-25.
- The Technical Writer*. By J. W. Godfrey, G. Parr. (Chapman & Hall, London; India: Asia Publishing House, Bombay-1), 1959. Pp. 340. Price 45 sh.
- Advances in Pest Control Research*, Vol. II. Edited by R. L. Metcalf. (Interscience Publishers, New York-1), 1958. Pp. vii + 426. Price \$12.50.
- Carnegie Institution of Washington—Year-Book 1957-58*. (Director of Publications, Carnegie Institution of Washington, Washington, D.C.), Pp. xi + 497. Price \$1.00.

SCIENCE NOTES AND NEWS

Lady Tata Memorial Trust

The Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1959, the awards of scholarships and grants for the year 1959-60.

International awards of varying amounts (totalling £5,065) for research in diseases of the blood with special reference to Leucaemias are made to: Dr. M. Simonsen (Denmark), Dr. M. Bessis (France), Dr. G. Klein (Sweden), Mr. P. A. Pillai (Switzerland), Dr. J. Ponten (Sweden), Dr. (Miss) B. M. Braganca (India), Dr. J. Hastrup (Denmark), Dr. E. Kelemen (Hungary), Dr. A. E. Stuart (Scotland).

Indian Scholarships of Rs. 250/- per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to: Miss M. H. Gandhi (Bombay), Mr. P. Suryanarayana Murthy (Bangalore), Mr. N. L. Tikotkar (Bombay), Dr. (Miss) M. R. Bakhtiar, (Bombay), Miss M. D. Menon (Cochin), Dr. R. K. Panja (Calcutta), Mr. G. N. Parvate (Bombay).

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships, which commences from January 1960, for research work on medical and allied subjects in recognised institutions situated in the Union of India.

The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipments or chemicals approved by the Board.

Applications in the prescribed form, which may be obtained from the Secretary-Treasurer, Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay-18, should be submitted before 30th September 1959.

Award of Research Degree

The University of London has awarded the Degree of Doctor of Science (D.Sc.) in Zoology to Dr. Satya Narayan Singh, Department of Zoology, Osmania University, Hyderabad, A.P.

The Utkal University, Cuttack, has awarded the Ph.D. Degree in Physics to Shri Kulamani Samal for his thesis on "Ultrasonic Propagation and Intensity in Liquid Media".

The Andhra University, Waltair, has awarded the D.Sc. Degree in Applied Physics to Shri V. Venkateswara Rao for his thesis entitled "Study of the Rotational Structure of $C_{12} +$ Bands"; D.Sc., Degree in Chemistry to Srimati G. Somidevamma for her thesis entitled "Analytical Chemistry of Iron III"; D.Sc. Degree in Geophysics to Shri V. V. R. Varadachari for his thesis entitled "Some Meteorological and Oceanographic Studies of the Coastal Waters"; and the D.Sc. Degree in Geophysics to Shri C. Balaramamurty for his thesis entitled "Studies on Physical Oceanography of the Western Bay of Bengal".

Symposium on Scientific Instruments

A symposium on scientific instruments is to be held at the Technical Development Establishment (Instruments), Dehra Dun, under the auspices of the Research and Development Organisation of the Ministry of Defence, on November 4, 5 and 6, 1959.

The deliberations are expected to cover all the aspects of instrument industry in India—its present potentialities and future expansion, design and development, inspection and gauging, testing and certification, rationalisation and standardisation, storage, preservation and tropicalisation, etc.

Papers intended for presentation at the symposium should be addressed to the Convener, Dr. C. S. Rao, Superintendent of Development, T.D.E. (Instruments), Dehra Dun, so as to reach him on or before July 31, 1959.

Indian Standards Convention 1959

The fifth Indian Standards Convention is scheduled to meet at Hyderabad from 27th December 1959 to 2nd January 1960. The previous four Conventions were held at Calcutta, Bombay, Madras and New Delhi respectively. The Convention will divide into nine technical sessions, covering subjects like the Implementation of Indian Standards; Standardisation and productivity; Design for industrial experimentation; Tropicalisation of electrical and electronic equipment; Latest techniques in chemical analysis; Documentation; Certification for small industries products, etc.

Dr. Irving Langmuir's Complete Works

The complete works of the late Dr. Irving Langmuir are being collected for publication.

in a set of six volumes, according to an announcement by Pergamon Press Inc. of London and New York. Dr. Langmuir, who was associated with the General Electric Research Laboratory from 1909 until his death in 1957, was the first American industrial scientist to receive a Nobel Prize. Among the scientific areas in which Dr. Langmuir made outstanding contributions were: high vacuum, solid surfaces, heat conduction, thermionic and gaseous discharges, monolayers, structure of liquids, aerosols and nucleation. A group of 29 leading scientists from throughout the world will serve as members of the Editorial Advisory Board for the Langmuir books. It is hoped that publication of the first of the volumes can be made before the end of 1959.

Five Thousand Revolutions around the Earth

On May 8, at 1-54 a.m., Moscow time, Sputnik III completed its five thousandth revolution around the earth. Sputnik III has now been in flight for 358 days and has covered 228,200,000 km. The first earth satellite in the world, which was launched on October 4, 1957, survived for 94 days, performing 1,440 revolutions around the globe. Sputnik II survived for 163 days performing 2,370 revolutions. When Sputnik III was put in orbit, its maximum distance from the earth (apogee) was 1,880 km., and its period of revolution, 105.95 minutes.

By the time of its five thousandth revolution, the satellite's period diminished to 99.51 minutes, and the apogee of its orbit, to 1,275 km.

To this day both the solar batteries and the chemical sources of power in Sputnik III continue to operate, which makes it possible to monitor it even when it is not illuminated by the sun and is in the earth's shadow. For the results of all the measurements and investigations conducted by means of the satellite to be fixed with respect to place and time, it is necessary to have an exact knowledge of the parameters of its orbit. With this purpose a special automatic measurement centre was set up in the Soviet Union, equipped with the most up-to-date radio instruments. The work of this centre has made it possible to determine the elements of the satellite's orbit with a precision far superior to the precision with which the parameters of the first two satellites' motion were measured.

Since the time of its launching it has been monitored by more than 80 optical stations and observatories throughout the territory of the

Soviet Union and over 110 similar stations abroad.

In the period that Sputnik III has been in existence, the co-ordinating-computing centre has issued more than 29,000 ephemerides (statements of computed places) to Soviet monitoring stations, and upwards of 23,000 to foreign centres. In the same period about 92,500 radio messages of the Sputnik's transmitter "Mayak", 10,900 optical observations of the Sputnik by Soviet monitoring stations and observatories and 3,820 observations sent in by foreign stations have been received and treated. Numerous photographic and high precision kine-theodolite observations of the Sputnik have proved highly valuable.—*USSR News*.

A New Ionospheric Phenomenon

Sporadic radio-frequency radiations which are observed sometimes are associated usually with auroral activities. However, as similar effects could be caused by man-made noise or interference, it becomes difficult to establish in an unambiguous way the origin of such unusual radiations. With the object of studying these radiations the Experimental Station at Jodrell Bank initiated a special programme of work, the experimental arrangement of which consists of five separate total-power receivers, all on slightly different frequencies near 80 Mc./s., with the corresponding aerials suitably directed to monitor continuously various sectors of the sky. Two of these aerials are directed at 30° elevation above the northern horizon, one is directed at the zenith, one at 30° above the southern horizon, and the last is rotated continuously so that Cassiopeia 23N5A is always in the beam. Three of the equipments are in Jodrell Bank and the other two are on individual sites 1 km. away. This experimental arrangement allows easy discrimination against localized interference at any one site, and against distant narrow-band radio-signals.

Normal records from the equipments show the expected diurnal variation due to the galactic background and, in addition, the southern aerial records, radio bursts and noise storms of solar origin. However, during the period January 3-10, 1959, there occurred about ten instances of isolated increases in the noise-level recorded by some of the instruments, together with *simultaneous decreases* in the others. A further very striking isolated event occurred on March 25, 1959, at about 1400 U.T. The records of this event are as follows: (i) The two northerly channels

showed *very strong enhancements*, about 200-400%, in the signal level; (ii) The apparatus continuously following Cassiopeia, which at the time had its aerial toward the north-west, showed a *strong enhancement* of about 50%; (iii) The zenith instrument recorded a marked decrease of at least 50%. The Jodrell Bank magnetometer revealed a change in the horizontal component, about 50 γ , coinciding with these observations.

This event, with its *simultaneous radio-frequency emission and absorption* in different sectors, was more intense than any observed in the January 1959 series. The suggestion has been made that this phenomenon is caused by passage through the ionosphere of streams of charged particles of very high velocity presumably of solar origin. In the upper ionosphere such particles stimulate the generation of radio-frequency energy while at lower levels the result is a net absorption of the background signal. The absorption mechanism is rather well established, especially in polar regions, and may be attributed to the production of abnormally dense ionization in the lower ionosphere. However, very little is known of processes which can generate radio-frequency noise in our atmosphere. It is believed that the impact of charged particles, both of high velocity and high density, is consistent with the environment for production of Čerenkov-type radiation. Other processes are also being considered. It is significant that these isolated events seemed to be the precursors of a period of intense solar activity with associated terrestrial events such as magnetic storms and auroræ.—*Nature*, 183, No. 4669, 1178.

Argus Experiments. Artificial Creation of Electron Belt by High Altitude Atomic Bursts.

The underlying idea for the Argus experiments was due to Nicholas C. Christofilos, Physicist of the Lawrence Radiation Laboratories of the University of California. In October 1957 he called attention to the fascinating physical effects which might be expected to follow an atomic burst in the near-vacuum of outer space, high above the earth and its dense atmosphere. Of the various effects contemplated, the most interesting one promised to be the temporary trapping of high-energy electrons at high altitudes in the magnetic field of the earth. Following the burst there would be thrown off in all directions nuclei of intermediate atomic weight. Most of these

nuclei, as is well known, are radioactive and subsequently decay with the release of energetic electrons and γ -rays. Most of the decays occur within a few minutes. The fission fragments themselves are electrically charged and move at high velocity. Hence their paths in the near-vacuum conditions of outer space would be controlled, in the main, by the earth's magnetic field and would be helical ones around magnetic lines of force. The electrons resulting from their decay would likewise move in helical paths in the magnetic field. In accordance with the theory of such motion it could be expected that these high-energy electrons would be trapped in the outer reaches of the earth's magnetic field and would only slowly leak down into the atmosphere and be lost due to collisions with air molecules in the tenuous upper atmosphere. The trapping region would be in the form of a thin magnetic shell encircling the earth and bounded by lines of force. Trapping times ranging from minutes to weeks were estimated for electrons whose helical paths ranged as close to the solid earth as 100 to 2,000 miles, respectively.

As reported already [*Curr. Sci.*, 28 (4), 144] the atomic bursts occurred on August 27 and 30, 1958, in the early morning hours and on September 6, shortly after midnight. In order to produce an electron shell having quantitative significance, it was desirable to minimise the loss of electrons to the atmosphere, and calculations showed that this could best be done by placing the source of the shell between longitudes 0° and 30° W. This follows from the fact that the earth's magnetic axis is tilted and displaced with respect to its rotational axis, so that the edges of the shell would come closest to the surface at these longitudes. The approximate latitude was 45° S. The site of the tests was such as to place the artificially injected radiation shell in a region where the intensity of the natural radiation had a relative minimum.

The directness and clarity of the artificial injection tests have provided a sound basis for interpretation of the natural radiation trapped around the earth. It is likely that many important contributions will continue to arise from the great diversity of geophysical observations being conducted by other countries participating in the International Geophysical Year.—*From White House Reports on the Argus Experiments.*

Heart Faults by Recorder Device

"Inject into the arm and watch the ear" is, in short, the method in this new device for

recording faults in the human heart. An innocuous dye is injected into the patient's arm. It is carried around the blood-stream until it becomes so diluted that the dye concentration reaches a uniform low level. During dilution which lasts about 12 seconds dye concentration is continuously monitored. This is done by passing a beam of filtered light through the lobe of the patient's ear to a photo-electric cell. Variation in dye present in arterial blood causes changes in cell output. This voltage is fed to the recorder.

The high-speed recorder, which operates on the continuous balance potentiometer principle, is designed to register full-scale travel (one millivolt) in one second. A special amplifier provides sufficiently fast response.

The normal curve shows a sharp initial peak followed by rapidly decreasing secondary peaks, thus, recording a steep disappearance curve. In an abnormal condition, e.g., a hole in the septum, blood continuously circulates to the lungs and back without reaching the main circulation. In this case when dye is injected, only part of it is pumped out into the aorta, and the record shows a lower initial peak and the disappearance curve is shallower and longer.—*Electronics*: 32 (8), 74.

Powder Pattern Technique for Domain Structure of Crystals

A new method has been evolved by Bell Telephone Laboratories for delineating the domain structure at the surfaces of ferro-electric crystals. In this method colloidal suspensions of commercial spray-grade sulphur and red lead oxide, each suspended in hexane, are separately used for the delineation technique. Although the colloid as a whole is electrically neutral, individual particles acquire a diffuse, double-layer charge when brought in contact with the liquid, and when a few drops of the suspension are applied to the face of the crystal, under the influence of the "built-in" electric field, the colloidal particles are attracted either to the positive or the negative domains depending on the orientation of their dipole layers.

Thus using sulphur suspensions in hexane, the sulphur deposits on negatively charged domains. If after the hexane has completely evaporated, the second suspension of red lead oxide in hexane is applied, the lead oxide

deposits on the positively charged domains. With sulphur and red lead oxide the delineation is brightly coloured and the pattern shows great details.

A dispersion of a cross-linked polymer derived from polystyrene can also be used as the negatively charged colloid, in place of the lead oxide. This can be dyed any desired colour with an oil soluble dye. Hexane is used as the insulating dispersion medium because its low viscosity and low dielectric constant allow the charged particles to move freely toward the ferro-electric domains under maximum electrostatic attraction.

This new powder pattern technique has provided the first information available on the domain structure of a number of ferro-electric materials such as triglycine sulphate and guanidium gallium selenate hexahydrate. It has also confirmed the results of optical and etching methods of delineating domain structure in several crystals.

A New Method of Growing Germanium Crystals

Westinghouse Laboratories report a new technique for growing germanium crystals in the form of thin, uniform flat ribbons. To process conventional germanium ingots into useful form, they must be sliced into thin wafers, ground to the required thickness, further cut into small squares and finally polished. Only then is the germanium ready to be fashioned into finished transistors and other devices. In this processing nearly 80% of the material is thrown away as germanium 'sawdust'.

In the new method it is claimed that the material "grows" directly in the exact form in which this semiconducting substance is used for practical purposes in transistors and similar devices. The new method could radically improve existing methods of making transistors. One can visualise, for example, the process at work in a machine that continuously, automatically, and at high speed turns out finished transistors directly from an input of raw germanium and the two or three other materials required to put a transistor into final form.

The new method may lead to the development of outer-space electronic equipment a thousand times smaller and lighter than anything now in existence.

THE PRINCIPLE OF HUYGHENS AND THE DIFFRACTION OF LIGHT

SIR C. V. RAMAN

1. INTRODUCTION

WHEN we speak of the diffraction of light, we have in mind certain effects which are observed when the free propagation of light is modified or influenced by the presence of obstacles in its path. It is clear that the nature of the obstacles, including especially their optical properties and their configuration in space, would determine these effects. Surprisingly enough, theories of diffraction have found general acceptance in which these factors receive very inadequate consideration. This situation is connected with the historical development of the subject and has arisen out of a misunderstanding of the ideas originally put forward by Huyghens in his celebrated *Treatise on Light*. A precis of the first three chapters of that treatise was given in a recent article in *Current Science*, and it was shown that the so-called principle of Huyghens as enunciated by later authors and made use by them as a basis for the theory of diffraction finds no warrant or support in the treatise. Huyghens did indeed introduce the concept of particular or partial waves and made effective use of it. But these partial waves of Huyghens had definite physical origins and the role which they played could therefore be readily understood. In these respects they differed radically from the ideas ascribed to him by later authors.

Theories clothed in the language of mathematical analysis have not infrequently found supporters and gained acceptance even though the physical ideas on which they are based are unsustainable. Kirchhoff's so-called rigorous formulation of the principle of Huyghens is a case of this kind. A statement often made and generally believed is that the Kirchhoff theory describes the experimental facts of the diffraction of light in a satisfactory manner. This belief has undoubtedly contributed to an uncritical acceptance of the ideas on which that theory is based. It is one of the objects of the present communication to show that it is indeed possible to make Huyghens' concept of partial waves the basis for a treatment of diffraction problems. This leads to results which are in agreement with the facts of experiment but are quite different from those indicated by the Kirchhoff theory. It follows that the latter theory is unsustainable and must accordingly be laid aside.

2. THE WAVE-OPTICS OF HUYGHENS

Huyghens sought in his treatise to explain the three most familiar facts of geometrical optics on the basis of wave principles, *viz.*, that the rays of light are propagated in straight lines; that the angles of incidence and reflection are equal; and that in refraction the ray is bent according to the law of sines. His explanations rest on the assumptions which he made regarding the structure of the luminiferous medium and the nature of light waves. His arguments led him to infer that in a homogeneous medium, each little piece of the primary wave emerging from a source of light is capable of travelling in a direction normal to itself more or less independently and that the primary wave-front is the locus or surface at which all the little pieces of which it is made up arrive together at the same instant. The same idea underlies Huyghens' explanation of the laws of reflection and refraction. Each piece of the original wave-front on reaching the boundary between two media is unable to continue on its original course by reason of the velocity of light being different in them. Accordingly it takes fresh paths, one in each of the two media, the direction of travel being such that the pieces of the original wave-front which are diverted from their path can all join up together again to form new wave-fronts in each medium. The latter requirement leads immediately to the equality of the angles of incidence and reflection in the first medium and to the law of sines for refraction into the second medium. This explanation was put into geometric form by Huyghens and is both simple and convincing. Regarded as a physical theory, it is highly successful, since it demonstrates that the refractive indices of the two media are in the inverse ratio of the velocities of light in them.

Examining the ideas of Huyghens in detail, it becomes apparent that his explanation of the rectilinear propagation of light cannot possibly serve as a starting point for a theory of diffraction. On the other hand, his theory of reflection and refraction does offer itself as a basis. For, it makes use of the idea that each element of area of the boundary between two media on which light is incident is a source of partial or secondary waves in the two media. Conceptually, these waves can diverge from each element in various directions, but the requirement

imposed by the theory of Huyghens that the disturbances originating at the different elements of area should arrive simultaneously at a common wave-front fixes the actual direction of their movement. If, instead of considering light waves as impulses, we take account of their periodicity and also of the possibility of interferences between the secondary or partial waves having their origin at the different elements of area on the boundary, the restriction of the observable effect to precisely defined directions ceases to exist. In other words, the diffraction of light becomes a possibility.

That the diffraction of light stands in the closest relation to the phenomena of reflection and refraction is also otherwise obvious. As remarked earlier, an obstacle of some kind in the path of a light-wave is a *sine-qua-non* for the manifestation of diffraction effects. A discontinuity in optical properties in the region traversed by the light represents such an obstacle, and if it exists over a sufficiently extended area, it would necessarily give rise to reflection and refraction.

3. THE LAW OF THE SECONDARY WAVE

A theory of diffraction which bases itself on the original ideas of Huyghens has accordingly to consider the secondary waves having their origin at the elements of area of a boundary between two media of different refractive indices on which light is incident. There would clearly be two sets of such secondary waves travelling out respectively into the two media. The velocity of travel and the amplitude of the disturbance in the two sets being different, they must be considered as completely distinct from each other. If both media are isotropic, the configuration of the secondary waves in each medium would be hemispheres. It is evident also that the particular circumstances of the case, *viz.*, the refractive indices of the two media, the angle of incidence of the primary waves on the boundary and the state of polarisation of the incident light would determine the manner in which the energy of the incident radiation would be divided up between the reflected and refracted wave trains. These same circumstances would also determine the amplitude of the disturbance in the secondary waves sent out respectively into the two media.

A question of importance needing an answer is the manner of dependence on the angle of diffraction of the amplitude of the disturbance in the secondary waves. Considerations of an elementary nature enable us to deduce this.

The projection of an element of area dS of the boundary on the surface of the enclosing hemisphere would be $dS \cos \phi$, ϕ being the angle of diffraction measured from the direction of the normal to the reflecting or refracting surface. This projected area would be a measure of the contribution which the element dS would make to the luminous effect observed in the direction ϕ . This would accordingly be a maximum in the direction of the normal ($\phi = 0$) and zero along the plane of the boundary ($\phi = \pi/2$). Hence in the expression for the amplitude of the effect due to each individual element, $\cos \phi$ would appear as a multiplying factor. At a sufficiently great distance from the diffracting surface, the angle of diffraction ϕ may be assumed to be the same for all its elements of area. It follows that when the expression for the intensity in the diffraction pattern is evaluated by a consideration of the interferences between the effects of the elementary areas, $\cos^2 \phi$ would appear in it as a multiplying factor.

The foregoing results are obviously of very general validity in respect of the diffraction patterns of the Fraunhofer class observed in various circumstances. All that is required is that the diffraction arises by reason of the limitation of the area of a plane surface at which light is reflected or refracted or through which it is transmitted; in the case of reflection, the material may be either a dielectric or a metal. It is not necessary that the surface should be continuous or that it should have uniform reflecting or transmitting power over the entire area. It might, for example, consist of several parallel strips, thus forming a plane diffraction grating. Further, since refraction at the boundary between two media which differ only infinitesimally in refractive index is equivalent to a simple transmission, it follows that the result would also be applicable to diffraction patterns of the Fraunhofer class arising from the passage of light through apertures in opaque screens.

4. VERIFICATION OF THE OBLIQUITY LAW

Any elementary treatment of diffraction theory can only be expected to be valid when the linear dimensions of the diffracting aperture are large compared with the wave-length of the light. As the angular spread of the diffraction pattern would in these circumstances be small, an experimental test of the law of the secondary wave might seem impracticable. Fortunately, however, this is not the case. For, the angle of diffraction ϕ is

measured from the direction of the normal to the aperture and hence when the incidence of the light on the aperture is oblique, ϕ may be large enough for the factor $\cos^2 \phi$ to vary rapidly over the area of the diffraction pattern. Further, at such settings the diffraction patterns are spread out over a fairly wide angular range even when the dimensions of the aperture are many times larger than the wave-length. In these circumstances, the effect of the $\cos^2 \phi$ factor on the distribution of the intensity in the pattern becomes conspicuous and can indeed easily be observed and measured.

We may illustrate these remarks by considering a simple case, *viz.*, a diffracting aperture which is a plane strip bounded by parallel straight edges. As is well known, when the

extent determined by the circumstances of the case.

In the particular case of normal incidence of the light on the aperture, $\xi = \pi a \sin \phi / \lambda$, a being the width of the aperture, λ the wave-length and ϕ the angle of diffraction as already defined. More generally, when the light is incident on the aperture at an angle θ in a plane normal to its edges, $\xi = \pi a (\sin \phi - \sin \theta) / \lambda$. Differentiating this, we obtain $d\xi = \pi a / \lambda \cdot \cos \phi d\phi$. Hence as the incidence is made more oblique and $\cos \phi$ diminishes in value, the angular spread of the pattern determined by the increments of $d\phi$ becomes greater. The bands for which ϕ is greater than θ would also appear more widely spaced than those for which ϕ is less than θ . In these circumstances, the obliquity

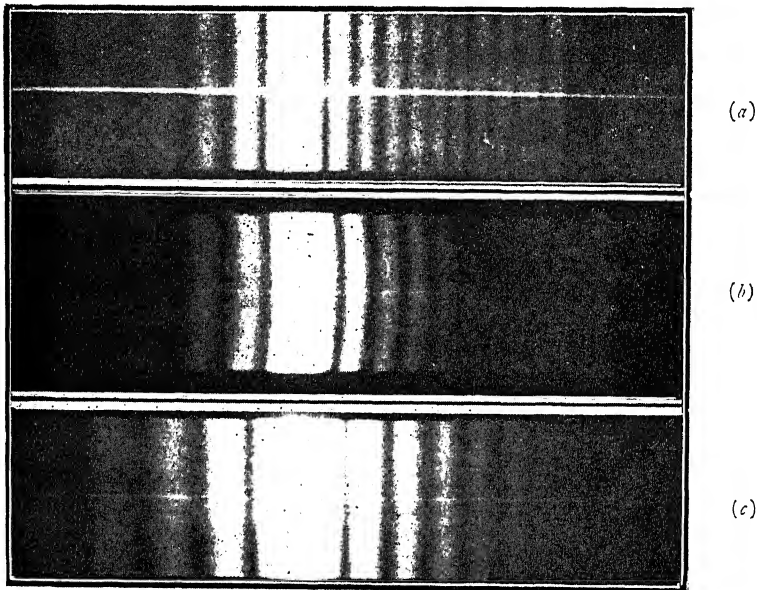


FIG. 1. Diffraction of Light by Rectilinear Apertures.

effects due to the infinitesimal elements of such an aperture are summed up, the expression obtained for the intensity in its Fraunhofer pattern includes a factor of the form $\sin^2 \xi / \xi^2$. This factor has a maximum value when $\xi = 0$, and vanishes when $\xi = \pm \pi, \pm 2\pi, \pm 3\pi$, etc. Since the value of $\sin^2 \xi / \xi^2$ is unaltered by a reversal of the sign of ξ , the graph of the function when set out with ξ as the abscissa is a symmetric curve in which the maxima on either side intermediate between the zero values are of equal intensity. The obliquity factor $\cos^2 \phi$ appearing in the expression for the intensity would, however, modify this situation to an

factor $\cos^2 \phi$ would have a very conspicuous influence on the character of the pattern. The bands for which ϕ is greater than θ would be much less intense than those for which ϕ is less than θ ; indeed as ϕ approaches the limiting value $\pi/2$, the intensity in the former cases would become vanishingly small.

5. THE RESULTS OF EXPERIMENTAL STUDY

The present theory of diffraction and that of Kirchhoff thus differ fundamentally in the observable results which they indicate. This is scarcely a matter for surprise since they approach the diffraction problem from completely different points of view. Whereas the

diffracting body or aperture plays the leading role in the present theory, it is not considered at all in the Kirchhoff formulation; the latter is based on the idea that the primary radiation from a source in free space can be represented as an integral in which the elements of area of a surface enclosing the primary source function as sources of secondary waves. The present theory leads to the result that the amplitude of the secondary waves emitted by the elements of the diffracting aperture vanishes in the plane of the aperture and increases progressively as we move away from that plane towards the direction of its normal. On the other hand, the Kirchhoff formulation indicates that the secondary waves have a maximum amplitude in the forward direction of the incident light rays and zero amplitude in the backward direction. The difference is of such a striking character that it is a simple matter by means of experimental study to decide between the two theories.

In view of the importance of the issue here raised for a correct understanding of the theory of the diffraction of light, an extended series of experimental studies have been carried out by the writer. Diffracting apertures of various sizes ranging from several centimetres down to fractions of a millimetre have been employed. The angles of incidence of the light on the apertures have been varied from normal right up to grazing incidence. The circumstances in which the diffraction manifests itself have also been varied to include various cases, e.g., the reflection of light at a plane surface of a dielectric or metal, the emergence of light after refraction through a transparent medium at various angles, the internal reflection of light within a transparent medium at incidences beyond the critical angle, and the transmission of light through apertures in plane opaque screens. The cases investigated include both simple and multiple apertures and plane diffraction gratings prepared by various techniques and operating by reflection as also by transmission. It will suffice here to state that in all the cases investigated, the consequences of the present theoretical approach have been completely vindicated by the facts of observation.

Fig. 1 (a, b and c) in the text are photographs of the diffraction of light at oblique incidences by a rectilinear aperture obtained by three different techniques. Fig. 1 (a) represents the diffraction pattern of the Fraunhofer class obtained with the monochromatic

light of a sodium lamp reflected by a plane polished surface of glass one millimetre wide

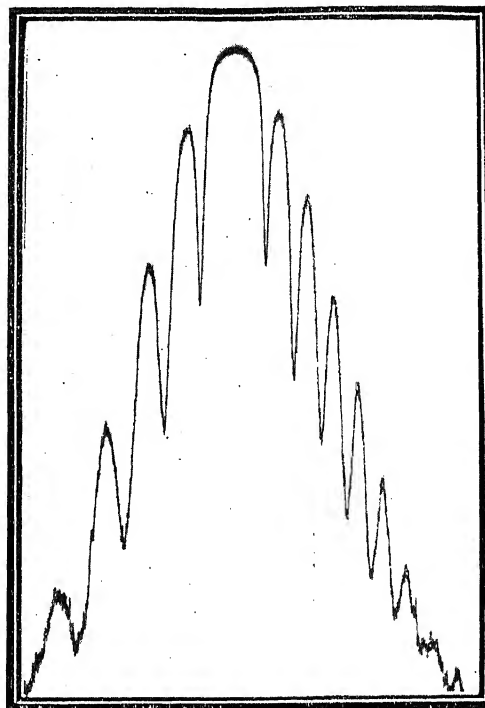


FIG. 2. Microphotometer Record of Fig. 1 (c).

at oblique incidences. Fig. 1 (b) represents a diffraction pattern observed when light emerges obliquely after refraction through a prism of glass, the rear face of which was covered up by an opaque film of silver except for a narrow slit with parallel edges scratched out of it. Fig. 1 (c) represents the diffraction pattern transmitted obliquely through a rectilinear slit formed by the edges of two razor blades held parallel to each other. It will be seen that all the three photographs show the characteristic features indicated by theory and discussed in the third paragraph of Section 4 above. It will be noticed that in each case the intensity of the diffraction bands falls off rapidly to zero on the side where they are broader and the number visible is quite small, while on the other side a great many fringes are seen, the intensity of which falls off very slowly. A microphotometer record of the pattern reproduced as Fig. 1 (c) appears as Fig. 2 in the text. The record shows very conspicuously the great difference in the intensities of the corresponding bands on either side of the central maximum.

RADIO-CARBON DATING

IT is well known that the phenomenon of radioactivity can be successfully applied to fix the age of materials, such as rocks and minerals, which contain radioactive elements. The method is based on the fact that the radioactive disintegration of nuclei follows strictly the laws of statistical probability and is wholly unaffected by external factors such as temperature, pressure, physical state, chemical combination, etc. The characteristic factor used in this age-determination is the 'half-life' period of the radioactive nucleus. It represents the time it will take for the amount of the radioactive material present at any instant to be reduced to one-half by radioactive decay. These 'half-lives' are widely different for different radioactive materials. For some they are small fractions of a second, and for others they are several thousands of millions of years. To tell the age of an object which contains some particular radioactive element, it is only necessary to measure what fraction of its original content has decayed away, whereupon a knowledge of the 'half-life' of the radioactive element concerned will enable one to calculate the age of the object.

In practice, it is necessary to choose an atomic nucleus whose 'half-life' bears some correspondence to the age it is intended to measure. Thus radioactive decay carbon, C 14, which has a 'half-life' of 5,570 years, can only conveniently be used, with all the recent refinements of measuring techniques, to measure ages up to about 50,000 years, for after a greater interval so much of the original material would have disappeared that the accurate measurement of what was left would be difficult. Uranium, on the other hand, has a 'half-life' of 4,500 million years. This makes it suitable as a means of measuring the ages of rocks formed at the beginning of the earth's geological history. It also follows that of the radioactive elements which may have been in existence when the earth was formed only those with the longest 'half-lives' will still remain in existence. This fact explains why plutonium whose 'half-life' is a few thousand years only, is now such a minute constituent of uranium-bearing ores. At first sight this would seem to imply that radioactive dating would have to depend entirely on longlived radioactive materials and thus it would only be suitable for the measurement of ages measured in hundreds of millions of years.

Fortunately this is not so. It turns out that some radioactive materials occur naturally on the earth because they are being created as quickly as they can disappear by spontaneous decay. One is radioactive carbon, C 14, and another is tritium, H 3.

Carbon 14, which has, as mentioned above, a 'half-life' of 5,570 years, is formed by the interaction of secondary cosmic ray neutrons on nitrogen atoms in the high atmosphere of the earth, at a height of 40,000 feet. From there the material is carried as carbon dioxide throughout the atmosphere until it becomes distributed more or less uniformly and indistinguishably from ordinary carbon in the oceans, and becomes incorporated in the structure of all living things.

This uniform mixing of radioactive carbon through the "Biosphere" of the earth provides one of the essential qualities which make it possible to use the substance as a means of dating. It has been calculated that there are something like 80 metric tons of radioactive carbon on the surface of the earth. This means that every gram of ordinary carbon taken from the atmosphere or from living materials should contain such an amount of C 14, that 16 atoms of it should break up by radioactive decay every minute. The products of this decay are an electron and a nitrogen atom.

The uniform distribution of radio-carbon only takes place within living matter however. Trees which have died no longer continue to absorb it and so the radio-carbon which they may have contained just before death continues to decay away according to the well established disintegration law. After 5,570 years only half of the original amount will be left. This leads directly to the method of measuring the ages of such things as archaeological or geological specimens of organic materials. One has to measure the content of radio-carbon in them and to compare this with the amount that would have been present if the material were still alive.

It is worth remarking at this point that the above argument in the calculation depends on the assumption that the intensity of cosmic rays has remained more or less constant during the last 10,000 years or so. In this connection it may be mentioned that as a result of the explosion of hydrogen bombs the radio-carbon concentration of the

atmosphere has been increased by as much as 10% in the last few years.

The practical difficulties of measuring ages by radioactive means are many. The chief difficulty is that the amount of radioactivity in a sample of rock or organic material is so small that it is very difficult to record the rate of radioactive decay without ambiguity—especially that arising from the presence of radioactive substances in laboratory atmosphere and apparatus. For radio-carbon dating special geiger counters have been devised to reduce these errors. The usual procedure in the dating of a material is to extract the carbon in the form of a gas (either carbon dioxide or acetylene) and to convert this either into solid carbon which may be incorporated into the walls of a radiation measuring device such as a geiger counter or to fill such a counter with the gas.

The ages of materials three or four thousand years-old can be measured with an accuracy of one or two hundred years, for ages up to 20,000 years the error may be a thousand years or so. Even here it is possible to tell with considerable accuracy the difference in the ages of similar samples. Radioactive carbon dating has now become a routine procedure in archaeology and geology and the National Physical Laboratory has established a unit at Teddington in the Applied Physics Division.

Apart from the archaeological applications, the radio-carbon dating method has been used to determine with accuracy the time at which the last Ice Age started to melt away. Thus examination of the remnants of mosses and lichens taken from glacial deposits in North America and Northern Europe has shown that the final retreat of the glacial ice started 10,300 years ago.—ISLO Science Newsletter.

FALL-OUT SINCE TESTS BEGAN

INFORMATION has been presented officially by the Ministry of Defence (U.K.) about the amounts of fission poisons released into the atmosphere by the explosion of nuclear bombs of one kind or another by U.S., U.K. and U.S.S.R.

This information has been made available so that those who are concerned with the making of estimates relating to radioactive fall-out can base their calculations upon actual figures.

In the tables the sizes of bombs have been given in units of a kiloton—the explosive equivalent of 1,000 tons of chemical explosive.

U.S. and U.K. Nuclear Events

(Yield in kilotons)

Year	Total fission yield
1945	60
1946	40
1948	100
1951	500
1952-54	37,000
1955	200
1956	9,000
1957-58	19,000

Soviet Nuclear Events

(Yield in kilotons)

Inclusive years	Total fission
1945-51	60
1952-54	500
1955-56	4,000
1957-58	21,000

U.S., U.K. and Soviet Events

(Yield in kilotons)

Inclusive years	Air burst	Fission yield		Total yield	
		Ground surface burst	Water surface burst	Air burst	Surface burst
1945-51 ..	190	550	20	190	570
1952-54 ..	1,000	15,000	22,000	1,000	59,000
1955-56 ..	5,600	1,500	6,000	11,000	17,000
1957-58 ..	31,000	4,400	4,600	57,000	28,000

The "Fission yield" of a bomb is an estimate of the amount of its explosive power derived from fission as opposed to thermonuclear fusion. It is directly a measure of the amount of fall-out poisons released into the atmosphere.

It is significant that the first great increase of world radiation was accounted for in the period 1952-54. Most of this is probably due to the bomb exploded at Bikini at the beginning of March, 1955.

The Ministry says that the yield of British and American thermonuclear bombs is on the average roughly half derived from fission and half from fusion. It has used this assumption about Russian bombs to calculate the amount of radioactivity released by them from the measured total yields of the explosions.

MINERAL CONTENT OF SHADED TEA LEAVES

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YOUNG shoots of the tea bush (*Camellia sinensis* L.) are harvested (plucked) repeatedly at set intervals, normally seven days. The weight of plucked shoots is known as 'yield' or 'pluckings'. Experiments at this station have shown that yield of populations of tea bushes can be increased by cutting out a fraction of the incident light.^{1,2} Screens of split bamboo mesh, used in these trials, were erected horizontally at a height of 6' from the ground. While reducing the illumination intensity incident on tea bushes to 50-60% of full sunlight, the screens altered the temperature and moisture status of the soil³: CO₂ concentration and relative humidity of the atmosphere might also have been affected. These changes presumably have effects on the soil micro-organisms and on the availability and uptake of nutrients by the tea roots, which, in their turn, would affect the growth of the tea bush and its capacity for shoot production. The increased shoot growth observed in these experiments, therefore, might have been due either to the reduced illumination intensity on the top parts of the bush or to the indirect effect of changes produced in the plant environment or to a combination of both. It was thought that the complications associated with the use of screens could be eliminated by confining observations to shaded and unshaded leaves and shoots on the same bush. This necessarily restricts the field of observations, but it was hoped that a difference in the chemical composition of shaded and unshaded leaves might still be observed, which would not only demonstrate the effect of shade *per se* but be a pointer for further detailed investigations. This report is a record of the results of an experiment designed on those lines.

Five pairs of leading shoots, which were neither tipped nor plucked, were marked on each of five bushes belonging to one clone. Three clones were chosen for the trial. Cylindrical baskets, 6" diam. by 18" length, of loosely woven bamboo strips, were inverted over one shoot of each of the five shoot pairs on 27th May 1958, and held in position with bamboo stakes. The object was to keep the apex of a shoot in reduced illumination intensity. To prevent the shoots coming in contact with the baskets before the conclusion of the experiment each

basket was fixed at a height such that the lower rim was in line with the middle of the third internode below the apex. The basket was not moved from this position. The mesh size of the basket was adjusted to provide an intensity of illumination equal to 50-55% of full sunlight. (As measured by a Weston photocell.) The five shoot pairs on a bush were selected at random and the random order was not usually disturbed except where the shadow of a basket fell upon an unshaded experimental shoot.

The three experimental clones, viz., 24/9, 3/198 and 19/29/13 were selected at random in a compact block of clones. The diameter of the clonal bushes was approximately one metre. The bushes were more or less contiguous, with densely grown top-parts, so that imposition of the baskets could have no influence on the illumination of the soil.

The leaf, which was wrapped round the apex of a shoot at the beginning of the experiment, was fully expanded by the end of June. This leaf was detached from the shoot on 1st July 1958. The petiole of the leaf was used for the count of calcium oxalate crystals defined as 'phloem index' by Wight and Barua.⁴ The laminae of all the five leaves of a bush, belonging to either of the two treatments, were dried to constant weight and then ashed at 500° C. Dry weight and weight of ash were recorded separately.

Data for leaf dry weight, absolute weight of ash, per cent. ash on dry weight, and phloem index are presented in Tables I-IV. Critical differences for all significant factors are shown at the bottom of each table.

TABLE I

Dry weight per leaf lamina in mg.

Clone		Light intensity		Average
		100 per cent. (Full sun)	50 per cent.	
24/9	..	517	548	533
3/198	..	442	425	434
19/29/13	..	238	228	233

L.S.D. at P = 0.05 : 95 mg. for clones.

TABLE II

Weight of ash per leaf lamina in mg.

Clone	Light intensity		Average
	100 per cent. (Full sun)	50 per cent.	
24/9	..	34.8	41.0
3/198	..	30.7	31.1
19/29/13	..	17.3	15.7

L.S.D. at $P = 0.05$: 7.0 mg. for clones.
: 4.2 mg. for clone \times light intensity.

TABLE III

Per cent. ash on dry weight

Clone	Light intensity		Average
	100 per cent. (Full sun)	50 per cent.	
24/9	..	6.728	7.482
3/198	..	6.959	7.305
19/29/13	..	7.234	6.905

L.S.D. at $P = 0.05$: 0.587 per cent. for clone \times light intensity.

TABLE IV
Phloem index

Clone	Light intensity		Average
	100 per cent. (Full sun)	50 per cent.	
24/9	..	71.4	56.6
3/198	..	46.2	43.5
19/29/13	..	80.4	89.3

L.S.D. at $P = 0.05$: 26.2 for clones.
do. : 9.5 for clone \times light intensity.

Clones were significantly different in respect of dry weight (Table I) and weight of ash per leaf (Table II). This was to be expected as the leaves were of unequal size. Leaf dry weight was not significantly altered by reduction of light intensity, but ash weight of clone 24/9, and not of the other two clones, was significantly increased. Table III confirms the results of Table II, and further shows that the trend of ash percentages of the three clones in full sun is completely reversed by shade.

Reduction of light intensity by overhead bamboo screens to 70 and 50% of full sun produced similar directional changes in the ash weights of plucked shoots and in phloem indi-

ces of a commercial tea population (Fig. 1) of the Assam variety (var. *assamica* Masters).

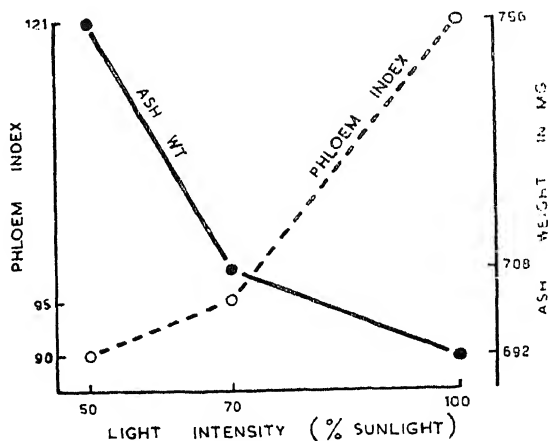


FIG. 1. The mean phloem index and the absolute weight of ash per 100 plucked shoots at different light intensities.

Clonal differences in respect of phloem index, shown by Table IV, were observed and reported in an earlier paper.⁴ The significant interaction between light and clone shown in Table IV demonstrates a differential response of clones to variation of illumination intensity. The interesting features of Tables II and IV are, however, the shade-induced changes of ash weight and phloem index, which are diametrically opposite in direction.

Reference has been made earlier to yield increase under bamboo screens. Approximately 90% of this increase can be attributed to a rise in the number of shoots. Shoot weight accounts for only about 10% of the increase (Table V). Data in Table V are based on six commercial tea populations grown in the sun and in 50% light intensity under bamboo screens. In view of these results, the dry weight of a sample of five leaves cannot be expected to increase significantly under reduced light. A difference in leaf dry weight of small samples is, therefore, no indication of the possible effect of shade on yield, which is primarily a function of shoot number.

TABLE V

Increase of shoot number and shoot weight due to 50% light intensity over full sunlight, in the absence of any added fertiliser

Per cent. increase in the number of shoots	..	89.0
Per cent. increase in fresh weight of a single shoot		6.5

Weight of ash is a rough and ready measure of the mineral content of tea leaves.⁵ Significant difference in ash weight of shaded and unshaded leaves on the same bush of clone 24/9 demonstrates that mere shading can produce a profound change in the mineral content of a leaf.

Higher mineral content of the shaded leaves is reflected in a diminution of the phloem index (Table IV). This is in line with the results of our previous investigations.⁶ Decrease in the phloem index of clones and populations (so far examined) was indicative of a condition conducive to an increase in yield. Similar considerations may apply to the present data.

Of the three clones used in the trial, clone 3/198 responded in a manner similar to clone 24/9 to variation of illumination intensity, although the changes of ash weight and phloem index were small and non-significant. The reaction of clone 19/29/13 to the particular shade density was opposite in direction.

The point at issue is the change, and not its direction, caused by shade on the mineral content of leaves. The data lead to the conclusion that the mineral metabolism of a tea bush can be altered by altering the illumination of the leaves without altering the illumination of the soil. It is also clear that the mineral content of the tea leaf is closely connected with the phloem index.

We are indebted to the Director of Tocklai and the Indian Tea Association, for permission to publish.

1. Wight, W. and Barua, D. N., *Rep. Indian Tea Assoc.* 1955, 30-34.
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3. Barua, D. N., *Ibid.*, 1956, 35-37.
4. Wight, W., and Barua, D. N., *Curr. Sci.*, 1954, 23, 78-79.
5. Portsmouth, G. B., *Tea Quarterly* (Ceylon), 1951, 22, 75.
6. Barua, D. N., *Curr. Sci.*, 1956, 25, 249-50.

ANALYTICAL CERTIFIED SOLVENTS FOR SPECTROSCOPY

THE rapidly increasing use of quartz spectrophotometers has created a demand for solvents of adequate ultra-violet transparency. A limited selection of the more useful solvents, both polar and non-polar, of high ultra-violet transparency have now been introduced by Hopkin and Williams Ltd., Freshwater Road,

Chadwell Heath, Essex. Later, they hope to include certain solvents specially tested for infra-red spectroscopy.

Analytical certificates will be issued with each container of solvent. Characteristics of some Spectrosol batches available at the present time are shown in Table I.

TABLE I
% Transmission (1 cm. cell) at given wavelengths (μ)

	400	300	275	250	245	240	235	230	225	220	215	210
Carbon tetrachloride	..	99	99	80	*	..	..	..	..	..	..	..
Chloroform	..	100	98	94	35	11	..	..	..	..	..	..
Cyclohexane	..	100	100	100	99	98	93	88	80	68	52	35
Ethylacetate	..	100	95	90	27	1.5	..	..	..	..	..	..
Ethyl alcohol	..	100	99	99	95	92	86	80	73	66	56	46
n-Hexane	..	100	100	99	98	98	97	94	92	88	82	71
Methyl alcohol	..	100	98	97	95	93	87	81	73	64	53	41
Iso-octane	..	100	99	99	99	98	95	94	91	83	68	28.5
Isopropyl alcohol	..	100	99	98	96	95	92	86	79	73	63	53

* 4.5 at 260 μ

THE EXPERIMENTAL CONTROL OF PLANT GROWTH*

ONE would have hardly imagined half a century ago, when the classical experiments on the effect of environment on photosynthesis, respiration and growth were conducted, that a day would come when man's ingenuity would create accurately controlled artificial environmental conditions where the mysteries of nature could be studied at great depth under almost perfect reliability and reproducibility of those conditions. Equally difficult to visualize two decades ago was the fact that this modern "phytotron" as they call it, could be constructed almost exclusively by air-conditioning and refrigeration equipments and that fluorescent lighting so popular in our domestic and industrial lighting programmes could provide all the light energy (comparable with the solar spectrum) needed for normal plant growth without dissipating heat into the plant growing chambers. Many in our country may consider it sheer luxury to grow plants under air-conditioned environment and perhaps the most enlightened administrator may shrink from a decision to sanction a phytotron to university centres of plant research. I, for one, would demur most emphatically and would commend the reading of this delightful book to those that might view it in that light and feel certain that they would change their minds. In a vast agricultural country like ours, technical aid of this kind to fundamental workers appears a necessity. In my view it would not be enough to build a large phytotron in any one centre; indeed, the answer is to design smaller ones and make them available to active university and agricultural workers in India who have a sound record of work in plant physiology, pathology, embryology or genetics.

I shall now pass on from general considerations to a brief statement of the valuable contents of this book. The scientific, technical and financial resources of the famous CALTECH (California Institute of Technology, Pasadena) and the Clark Greenhouses and Earhart Plant Research Laboratory have enabled the installation of this phytotron with much thought and ingenuity. The construction costs of \$407,000 came from the private munificence of the Earhart Foundation and the technical skill that went into the construction came from a close liaison between scientists, engineers, architects and administrators. The yearly

costs, including salaries of operating staff and maintenance is mentioned as \$60,000. The general principles of air-conditioning, refrigeration, spraying of cold water continuously during the day on the green-house glass roofing (which absorbs as much as 20% of the infrared) and details about artificial lighting and the control room, ballast and transformer housing as well as the use of automatic CO₂-analyzers are excellently set out. Methods of handling plants are also very well described. The research projects covered in these controlled houses are far too many to be enumerated here. Suffice it to say, that much of what has been achieved should be an eye-opener to many botanists particularly, the observations on nyctotemperatures and the effect of controlled temperature, light, etc., on genotypic and phenotypic variability.

A statement of significance appealed to the reviewer in the concluding chapter of this book, viz., that if we are to raise the study of plant science to those of the "exact" sciences, experiments with plants have to be carried out under rigidly controlled conditions and that inadequate experimental techniques as hitherto prevented the development of a "Theoretical Botany" compared to "Theoretical Physics". This should be wholly endorsed as much data of significance to the physiologist, geneticist, horticulturist and agronomist and those interested in climatological studies and plant growth as a world problem could emanate from these phytotrons. Many botanists outside the U.S.A. have also realised the importance of constructing phytotrons; notably, Sweden has a modern version and most of us in this country have recently heard an exposition on the construction of this at Uppsala from Prof. Nygren. Indeed, the Uppsala unit has an electronic brain controlling the operation of this unit and any breakdown raises an alarm round the clock communicated to the researcher over the telephone.

There could be little doubt that this book is to be most warmly commended as a reference book in all botanical laboratories and, I suppose, architects, technologists, physicists and engineers would benefit by reading this as here lies the future of plant research. The botanist by himself may not be up to the task and would not be able to construct these phytotrons without collaboration if he were not to waste national resources by a "trial and error" method of construction.

T. S. SADASIVAN.

* *The Experimental Control of Plant Growth*. By F. W. Went. (Chronica Botanica Co., Waltham, Mass.), 1957. Pp. xvi + 343. Price \$8.50.

LETTERS TO THE EDITOR

EFFECT OF AGING ON ISOTOPIC
EXCHANGE BETWEEN RADIOACTIVE
BROMINE AND ORDINARY BROMINE
RADICALS IN AgBr

THE rate of isotopic exchange between radioactive Br^* and ordinary Br radicals, under identical conditions of temperature and time of stirring, with equal quantities of AgBr precipitate but "aged" differently has been studied. It has been found that the exchange rate is greater with fresh precipitates of AgBr than with the aged. The effect of temperature has also been studied.

Equal quantities (15 ml. each) of ethyl bromide, contained in six long glass tubes, were irradiated for 40 hours in a neutron flux from a radium-beryllium source. To extract radioactive bromine, Br^* , the contents of one of these tubes were mixed with 0.2 ml. of KBr containing 10 mg. of Br per ml. and 3-4 ml. of water and two drops of SO_2 solution. The solution was vigorously shaken for two minutes and then allowed to settle. The EtBr was then run off and the aqueous solution was poured in a centrifuge cone. To this were added 5 drops of HNO_3 and a small quantity of AgNO_3 and the solution was then centrifuged and the precipitate was washed first with water containing 3 drops of HNO_3 , then twice with acetone. It was then mounted on a weighed counting tray. This untreated AgBr^* served as the original sample in subsequent experiments. Its activity at any time gave the total activity of Br^* at that time.

Next, 600 mg. of AgBr precipitate were prepared from KBr and AgNO_3 and the time of precipitation was noted. The precipitate was put in a large test-tube covered with black tape. One of the large tubes containing 15 ml. of the EtBr* irradiated in the neutron flux was then poured out into the precipitate. The AgBr precipitate in EtBr* was then gently stirred for 75 minutes by means of an electric stirrer. The contents were then centrifuged and EtBr rejected. After washing with CCl_4 four times, a part of the precipitate was mounted on a weighed counting tray, and its activity measured under a G.M. counter. This served as fresh sample I.

Three more samples, 600 mg. each, of AgBr were prepared using the same reagents. Three

samples were put in similar tubes covered with black tape. Equal quantities of ordinary EtBr were put in these tubes. All the three samples were placed in a thermostat whose temperature was adjusted at 27°C . One sample was allowed to age in the thermostat for one hour, the second for 19 hours and the third for about 41 hours. After aging, the content of one of the remaining irradiated EtBr* solutions was poured in each of the samples. The contents were stirred for 75 minutes in the thermostat and then centrifuged, washed and mounted on weighed trays.

The activity of each was measured and compared with the activity of the original sample at that time. From this, the percentage activity removed by samples of different age was calculated.

Another set of experiments was performed in which isotopic exchange was studied under the same conditions as in the above set except that the temperature was 37°C ., only 2°C . below the boiling point of EtBr.

TABLE I
Percentage activity removed by AgBr^*
samples of different age

Age	Percentage activity removed	
	At 27°C .	At 37°C .
Hr. Min.		
0-20	77	82
1-20	46	73
19-0	24	56
41-20	22	45

These experiments show that the rate of exchange between radioactive bromine Br^* and

ordinary Br under identical physical conditions is a function of the age of the precipitate. The exchange rate decreases with age. It was also found that the exchange rate increases with rise of temperature, other conditions being the same. It appears aging of the AgBr crystals is a slow process. Constant rate of exchange was not attained even after 41 hours.

Fresh crystals have an imperfect lattice and, therefore, a large specific surface. With age, the crystal lattice becomes more and more perfect and therefore the specific surface becomes

relatively less. Due to the decrease in specific surface, the exchange rate decreases. The cause of the large disparity between the exchange rates at different temperatures is not quite clear. The higher activity at elevated temperature may be due to the higher rate of diffusion of Br^* into the silver bromide lattice.

It may be added that errors due to self absorption, back-scattering, etc., were made almost equal in all samples by taking very nearly equal amounts of precipitate and spreading them as uniformly as possible away from the edges on similar counting trays. As AgBr is photosensitive, precipitation of AgBr was done in a darkened room with only a small red lamp on. Tubes containing the precipitate were wrapped with black tape. All the subsequent operations—aging, stirring, centrifuging, washing, etc.,—were also performed in red light.

The author's sincere thanks are due to Dr. K. F. Chackett of the Birmingham University, U.K., for suggesting the problem and affording all facilities for carrying out the experiments.

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January 17, 1959.

COMPARISON OF THE MEAN SIZES OF THE VIRUS-LIKE PARTICLES ENCOUNTERED IN MAMMARY CARCINOMA IN MICE OF DIFFERENT INBRED STRAINS

ELECTRON microscope study of thin sections of breast tumor tissue from inbred strains of mice has revealed the presence of two characteristic types of particles, namely, the intracytoplasmic particle (Fig. 1a) and the extracytoplasmic particle (Fig. 1b).⁵ These particles have been observed in tumors obtained from three different inbred strains, dba (old & new), C_3H and Strong A, maintained in the mouse colony of the Indian Cancer Research Centre. The biological properties of the different strains have already been published.^{3,4} Some workers suggest on the basis of the morphological characteristics and size range that these particles might represent the Bittner's milk agent.^{1,6}

The size ranges of the particles described in electron microscope studies of thin sections of mouse breast tumor tissues from different laboratories are in close agreement. However, a comparison of the size of the particles observed in breast tumors from different strains of mice has not yet been reported. A preli-

minary study of such a comparison, carried out on tissues that have been processed identically, is reported here.

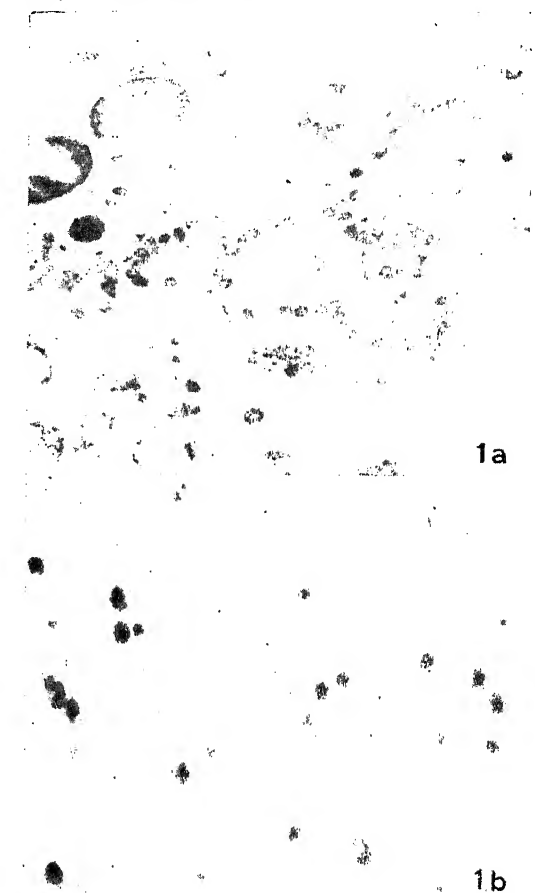


FIG. 1a. Electron micrograph showing group of particles of the intracytoplasmic type arranged round membrane bound vacuoles. Magn. $\times 30,250$. FIG. 1b. Electron micrograph showing particles of the extracytoplasmic type. Magn. $\times 41,800$.

TABLE I
Number of particles measured

Strain	Intracytoplasmic particle	Extracytoplasmic particle	Dense region
dba (old)	148	127	112
dba (new)	126	302	262
C_3H	144	443	428
Strong A	441	17	17

Table I shows the number of particles measured in the different strains of mice. The mean sizes of the two types of particles in the different strains together with the respective

standard error of the means is shown in Table II. Table III shows the results of the comparison of the mean sizes of the particles in the different strains considered two at a time. As indi-

TABLE II
Mean size in Angstroms

Strain	Intracyto- plasmic particle	Extracyto- plasmic particle	Dense region
dba (old) ..	625.15 ± 10.04	822.744 ± 3.666	404.95 ± 7.546
dba (new) ..	606.54 ± 8.066	816.89 ± 6.613	424.35 ± 4.508
C ₃ H ..	674.5 ± 7.169	868.75 ± 2.615	495.71 ± 4.527
Strong A ..	634.2 ± 4.098	1049.03 ± 3.790	501.9 ± 14.92

cated in the table, significant differences in the mean sizes of the intracytoplasmic particle are observed in the dba (old), dba (new) and A strains when compared with the value for C₃H strain. A comparison of the mean size of the intracytoplasmic particle in the dba (new) and A strains also shows a significant

TABLE III
Difference in mean size in Angstroms

Strain combination	Intracyto- plasmic particle	Extracyto- plasmic particle	Dense region
C ₃ H × dba (old)	49.35 ± 12.34†	46.01 ± 4.503†	90.76 ± 8.804†
C ₃ H × dba (new)	67.96 ± 10.79†	51.86 ± 7.112†	71.36 ± 6.472†
C ₃ H × Strong A	40.3 ± 8.26 †		
dba (old) × dba (new)	18.61 ± 12.87	5.85 ± 7.56	19.4 ± 8.788*
dba (old) × Strong A	9.05 ± 10.84		
dba (new) × Strong A	27.66 ± 9.04†		

Statistical significance

* P < .05

† P < .01

difference. Significant differences are observed in the average diameters of the extracytoplasmic particle including the central dense region in the C₃H and dba strains. In the dba (old) and dba (new) strains, only the mean size of the central dense region of the extracytoplasmic particle shows a significant difference.

The results are not conclusive for a biological interpretation of the virus-like particles observed in electron micrographs. However, the observations are interesting in the light of the report of a new strain of the mouse mammary tumor virus.²

The guidance rendered by Mrs. K. Jayant in the statistical computation of the results is gratefully acknowledged.

Electron Microscope Section, S. R. S. RANGAN.
Indian Cancer Research Centre,
Bombay-12,
January 28, 1959.

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ENERGY AND ENTROPY OF ACTIVATION OF REACTION BETWEEN TARTRATE AND ACID PERMANGANATE

THE reaction between tartaric acid and acid permanganate has recently been studied by Bafna *et al.*² who consider that the mechanism for oxidation is similar to that suggested by Alexander and Tompkins¹ for oxidation of 2, 6-dinitrophenol. The results reported in the present note, however, point to entirely different conclusions.

The reaction between tartrate and acid permanganate was studied at pH = 0.8 and at temperatures 25°, 30° and 35° C. The pH was adjusted by addition of requisite quantity of dilute solution of sulphuric acid, to a solution of tartrate. 100 ml. of acidified solution of tartrate (0.05 N.) and 100 ml. of permanganate solution (0.05 N.) were brought to the requisite temperature (± 0.01° C.) and then mixed in reaction bottle, also kept at the same temperature. 20 ml. of the reaction mixture were then drawn at known intervals of time and rapidly added to acidified potassium iodide solution. The iodine liberated was rapidly titrated with standardised solution of hypo. All reagents were of analar standard.

The reaction was kinetically found to be of second order. Good second order rate constants were obtained for early stages of the reaction. In the later stages of the reaction the rate constant was found to increase with time. This was established to be due to the autocatalytic effect of Mn⁺⁺ produced during the reaction. The calculated values of rate constants were checked with the graphical

values obtained from a plot of $x/(a-x)$ against time. The specific rate constants for temperatures 25°, 30° and 35° C. are given below in Table I, column 2.

Arrhenius equation was found to be valid for the reaction. The energy of activation, ΔE , calculated by this equation, came out to be 24.17 kcal. Using this value of ΔE , the frequency factor was calculated for the reaction at various temperatures. The values of this factor, pZ , are given in column 5.

TABLE I

Tartrate-permanganate reaction: Specific rate constants and frequency factor
Tartrate: 0.0125 M; Permanganate: 0.005 M;
pH: 0.8

Temperature ° absolute	$k \times 10^2$ litre mole ⁻¹ sec. ⁻¹		ΔE kcal.	pZ litre mole ⁻¹ sec. ⁻¹
	Expt.	Calc.		
298	1.133	1.167	24.17	6.98×10^{15}
303	2.333	2.278	..	7.38×10^{15}
308	4.399	4.444	..	7.14×10^{15}
Average		..	..	7.2×10^{15}

Using the values of ΔE and pZ , the specific rate constants at 25°, 30° and 35° C. were calculated. These are shown in column 3 of Table I.

The agreement between the experimental and the calculated values for specific rate constants is good. The entropy of activation calculated by taking $\Delta E = 24.17$ kcal. and $pZ = 7.2 \times 10^{15}$ came out to be +13 E.U.

For a reaction in solution involving ions of Z_a and Z_b , unit charges the entropy of activation ΔS is given by³

$$\Delta S \approx -10 Z_a Z_b$$

The value of $\Delta S = +13$ E.U. obtained, therefore, suggests that the rate determining step involves reaction between oppositely charged univalent ions, under the given experimental conditions.

Department of Chemistry, G. V. BAKORE.
Government College, Ajmer, RAM DAYAL.
March 29, 1959.

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CONDUCTOMETRIC STUDIES ON SILVER MOLYBDATES

A REVIEW of existing literature reveals that there is hardly any reference to the study of the silver molybdates obtained by the addition of AgNO_3 to a progressively acidified solution of Na_2MoO_4 . A. V. Novoselova,¹ and Svanberg and Struve² have reported the compounds $\text{Ag}_2\text{O} \cdot 3\text{MoO}_3$ and $2\text{Ag}_2\text{O} \cdot 5\text{MoO}_3$. The physico-chemical studies of normal Ag_2MoO_4 have been made by Saxena and Gupta.³ The various Ag-molybdates at different pH are studied by conductometric methods and the results are incorporated in the present note.

Standard solutions of A.R. quality reagents were prepared in conductivity water and used in the present work. The conductivities were measured by Kohlrausch Universal Bridge (W. G. Pye, Ltd.), keeping the titration cell immersed in a thermostat kept at $30^\circ \pm 1^\circ$. The conductance obtained after each dilution was corrected for dilution effect.⁴ Different concentrations of the reagents were used and titrations were also performed in aqueous-alcoholic media. The pH of the solution was measured with the glass electrode.

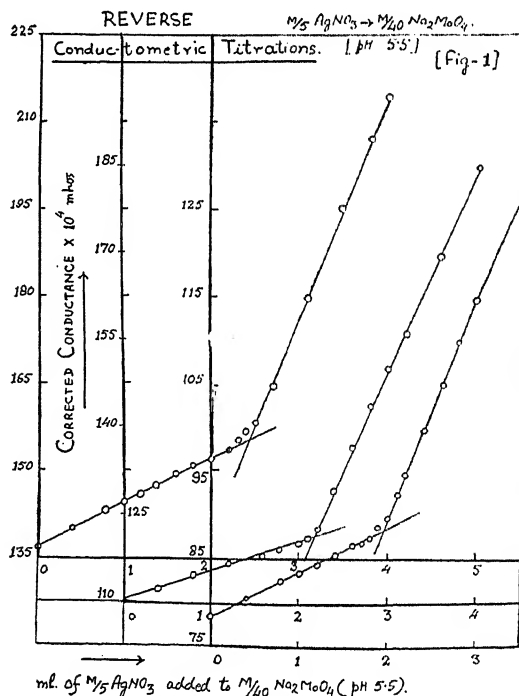
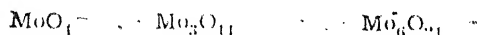


FIG. 1

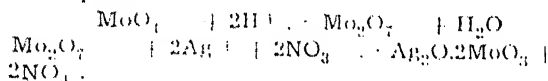
According to G. Jander and co-workers,⁵ the molybdate ion exists in the following state of aggregation depending on the pH of the medium.



pH 14 to 6.5, 6.5 to 4.5, 4.5 to 1.5

Different molybdate ions are in equilibrium and it is interesting to find different Ag-molybdates precipitating at different H ion concentration of a progressively acidified Na_2MoO_4 solution.

On addition of AgNO_3 from a micro-burette to Na_2MoO_4 acidified by HNO_3 to pH 4.5 to 6.0, it will be observed from Fig. 1, that conductance rises from the beginning as the ionic mobility of $2\text{NO}_3^- + \text{Mo}_2\text{O}_7^{2-}$ and on reaching the equivalence point, it still rises more due to the excess of Ag^+ by virtue of its high mobility. Probably the following reaction takes place.



Formation of dimolybdate confirms the presence of $\text{Mo}_2\text{O}_7^{2-}$ ion.¹

It will be observed from Fig. 2, that the conductivity curve consists of two rectilinear

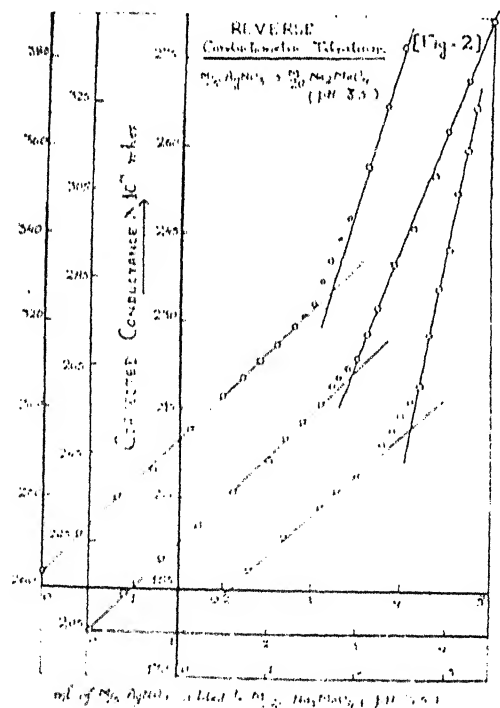


FIG. 2

branches with a sharp intersection at a point corresponding to the formation of silver trimolybdate $\text{Ag}_2\text{O} \cdot 3\text{MoO}_3$. Obtained by the addition of AgNO_3 to a progressively acidified solution of Na_2MoO_4 at pH 3 to 2.5. At this

pH, the trimolybdate ion is found to be in preponderance as suggested by Travers and Malaprade.⁶

In both cases, the precipitated Ag-molybdates when analysed for Ag and Mo contents yielded results in agreement with the conductometric measurements. The values of equivalence points in alcoholic media approach closely to the theoretical values, probably due to the fact that alcohol materially suppresses the solubility of various molybdates.

Chemical Laboratories, R. S. SAXENA,
Government College, C. M. GUPTA,
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SEPARATION AND ESTIMATION OF SUGAR COMPONENTS OF ALLIUM CEPA LINN. (N.O. LILIACEAE) BY PAPER CHROMATOGRAPHY

The bulb of *Allium cepa* Linn. (English onion) has been reported to possess useful medicinal properties.^{1,2}

Systematic investigation of the sugar fraction of the bulb has been carried by paper chromatography. 100 g. of onion, red and mature, was crushed, mixed with 100 ml. of distilled water and allowed to soak at 20° C. for 24 hours. It was filtered off and the filtrate was treated with animal charcoal to remove colouring matter and tannins. The clear filtrate so obtained was concentrated under reduced pressure to 10 ml. The concentrate was then employed for separation and estimation of sugars. The extract contained 2.8% reducing sugars.

Descending technique of Partridge^{3,4} was followed to develop the chromatograms. A mixture of *n*-butanol, acetic acid and water (4:1:5, v/v) in one set of experiments and iso-propyl alcohol, glacial acetic acid and water (7:2:1, v/v) in the second set of experiments was used as irrigating solvent in the liquid phase and phenol saturated ammonia

in the vapour phase. The chromatogram was run at 16° C. for 36 hours on Whatman No. 1 paper. The spraying reagent consisted of a 0.5% benzidine and 20% glacial acetic acid in absolute alcohol and 1% concentration of reference sugars was employed. After spraying the colours were developed by the method of Constan.⁵ The R_f values of the spots were determined. On the basis of R_f values and the preparation and identification of the derivatives of various spots obtained, arabinose, xylose, ribose and rhamnose were identified in the extract.

The quantitative estimation was made by elution of the coloured spot and colorimetry using a Klett Summerson Photo-electric Colorimeter. Xylose and ribose at times gave diffused spots in the form of a trail and at times double spots.

TABLE I
 R_f values of sugars and their quantities in
Allium cepa Linn.

Serial No.	Name of the sugar	R_f values		Quantities in mg. per 100 g. of the sample
		Solvent: <i>n</i> -Butanol acetic acid and water	Solvent: Iso-propyl alcohol, acetic acid and water	
1	Arabinose ..	0.22	0.33	996.8
2	Xylose ..	0.29	0.39	692.7
3	Ribose ..	0.32	0.44	657.0
4	Rhamnose ..	0.37	0.49	450.0

The authors are grateful to Dr. N. K. Chowdhury, Professor of Pharmacology, Medical College, Agra, for his keen interest in the work.

Chemical Laboratory, A. SINHA.
Department of Pharmacology, A. K. SANYAL.
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A NOTE ON THE METABOLIC PRODUCTS OF *HELMINTHOSPORIUM ORYZAE*

As part of a scheme of work on the metabolic products of fungi affecting rice plants and paddy, and in continuation of our earlier report on *Curvularia lunata*,¹ we have made

a preliminary study of *Helminthosporium oryzae* Breda de Haan which is responsible for the disease characterised by certain brown leaf and grain spots.² Raistrick *et al.*³ reported that *H. oryzae* did not produce any anthraquinone pigments or any ergosterol. While working with a strain of the organism obtained from the Central Rice Research Institute, Cuttack, we could isolate a small amount of ergosterol as one of the products of metabolism and the results are briefly reported.

A strain of the organism was cultured on Czapek-Dox medium for three weeks at 25–30° C. At the end of the period, it was found that about 80% of glucose had been utilised and the pH of the medium reached 9.2.

The aqueous culture filtrate was decanted from the mycelium and repeatedly extracted with chloroform. The chloroform extract did not yield any crystalline substance. The aqueous layer was acidified to congo-red with dilute hydrochloric acid and extracted with ether. The ether extract yielded a reddish brown amorphous residue, soluble in alkali and giving a brown colour with alcoholic ferric chloride. The culture filtrate did not permit any fungal growth even when it was kept exposed to atmosphere for a number of days.

The mycelial felt was disintegrated in a Waring blender in presence of acetone, filtered and washed with dry acetone. The fine powder (dry wt., ca 5.6 g./l. of the culture fluid) was extracted in a Soxhlet extractor with petroleum ether, chloroform and acetone in succession. The chloroform extract, which was a brown solid, on treatment with cold acetone yielded crystalline solid (yield, 0.03%) melting at 150–55° and giving positive steroid colour reactions. This was recrystallised from hot acetone when it came out as rectangular rods and thick plates. m.p. 163–64°; $[\alpha]_D^{25} = -128 \pm 3^\circ$ (chf.). The compound was identified as ergosterol by its analysis, colour reactions and its benzoyl derivative (needle, m.p. 166–67°). Comparison with an authentic sample of ergosterol⁴ (isolated from *Rocella montagnei*) and its benzoate was also made.

The acetone filtrate and washings obtained during disintegration of the mycelium in the Waring blender yielded a little more of ergosterol.

No anthraquinone pigment could be isolated from any of the extracts.

We are thankful to the Director, Central Rice Research Institute, Cuttack, for the strain

of the organism used in this investigation. We also thank Prof. S. Rangaswami for his kind interest in this work.

Dept. of Pharmacy, T. KRISHNA MURTY.
Andhra University, S. SANKARA SUBRAMANIAN.
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March 10, 1959.

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NOTES ON THE CHART OF DOWNBUCKLING*

THE chart of topo anomalies (Glennie, 1957; Fig. 1) bears a close relationship to the structural map of the Peninsula. Pronounced differences exist between the topographical relief and gravity relief.

The geological interpretation, based on the concept that the gravity anomalies are deep-seated and are as such, irrespective of the age, referable, in a general way, to the "basement rocks", leads to interesting conclusions.

Even a casual examination shows a mutual relationship between the gravity low areas and the Archæan eu-geosynclines. Thus the Dharwarian geosynclines comprising pelites, cherts, limestones, basic intrusions and spilites can be identified with the "Schist Belts", which probably are vestigial tectogenes.

"Fossil meinez zones", in the vicinity of the Maldivé Islands, and at the southern tip of India and Ceylon, had been suspected by Venning Meinez himself (Hans Stille, 1955). This is confirmed by the close resemblance, between the narrow zones of negative anomalies associated with island arcs and the elongated sinuous belts of low gravity values (Fig. 1) found along the western margin of the Peninsula.

The coincidence of the main charnockite massifs with the areas of low gravity is also remarkable. Incidentally, the major occurrences of ultra-basic rocks and the important chromite deposits either fall within or lie close to these low gravity zones—Fig. 1 (I, II, III and IV).

Evidence for such plastic deformation of the Peninsula is also found in the graceful curves, in trend lines of the foliation, indicating mobility and flowage (Krishnan, 1953). The downbuckle of the M-unconformity in I, II and III (Fig. 1) is of the order of -5 km., while that

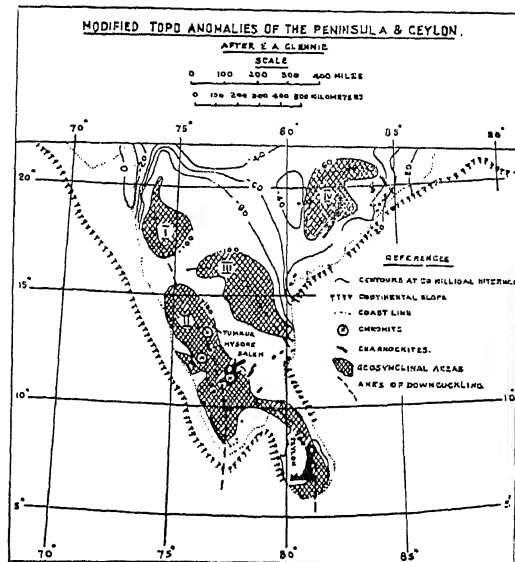


FIG 1

of IV is of the order of -2 km. (Glennie, 1957). There is, however, a general rise in downbuckling contours to the east of I and III, possibly indicating a downbuckle or a fault along the 80 mgal contour.

The necessary adjuncts to such large-scale downbuckling are anetexis, refusion, emplacements of sima and granitisation. Thus apparently the charnockite is a product of these processes, the early geosynclines being the ideal locations. This also explains the variation in composition (from ultra-basic to acid), texture of these rocks (from granitoid to granulitic) and the dimensions of the outcrops.

These rocks occur as massifs in the Shevaroy and Nilgiris, as bands in Coorg and as insignificant patches in certain areas in Madurai, Trichy, etc., not as differentiates from an all-pervading magmatic chamber, but as products of a catastrophic cycle, such as, a downbuckle.

Finally the trend of the isogamic contours with the convexity to the N.E. is significant. This feature suggests that possibly the down-

buckles were affected by a drift from the southerly direction.

R. N. P. AROGYASWAMY.

Geological Survey of India,
Southern Circle,
Madras-4,
August 2, 1958.

* Published with the permission of the Director, Geological Survey of India.

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AGMATITES FROM UPAL (HYDERABAD)

AGMATITES have been noticed near Upal, about 100 yards south of milestone 4/6 on Hyderabad-Warangal road. Angular and subangular blocks of basic enclaves are found in a granite matrix. The granite here is a coarse-grained pink rock, with a number of small patches of pegmatites. Though no pre-granite formations are known to occur in this area, the granite carries at many places a number of basic enclaves. The rock in the vicinity of the enclaves is generally though not everywhere either a streaky gneiss or a blotchy granite, relatively rich in ferromagnesian minerals. These enclaves and the associated gneisses have a regional north-northwest trend, though there are local variations. Some of these enclaves are schistose.

The agmatites near Upal are made up of angular to subangular block of basic material upto 4 feet across in size. At some points, they show a definite brecciated appearance

with large crystals of a pink felspar (4 to 10 inches). These pegmatites do not form large regular veins but are mostly in the form of small irregular bodies with diffuse margins, grading at places into thin aplitic veins. The streaky gneissose appearance of the rocks is due to thin long sinuous basic stringers. The blotchy appearance is due to clustering of ferromagnesian minerals into small clots. Similar occurrences of agmatites have been reported earlier by M. N. Saxena¹ from Bundelkhand granites.

These enclaves are at places full of thin veins of acidic (aplitic) material, giving rise to what Sederholm² has called *arterites* (Fig. 2) as opposed to the bizarre criss-cross breccia-like agmatite. At still other places there is an intimate intermingling of acidic and basic material retaining a hazy outline of the enclaves, which would correspond to Sederholm's *nebulite*. The agmatites, arterites and nebulites grade into one another and into granites which form the country rock.

Assuming that the basic enclaves are the relicts of the older formations, the younger acidic rock could have been emplaced either as a molten intrusion or by transformation of pre-existing rocks. In the former case, the arterites and nebulites would represent progressive stages of assimilation by the intruding magma. In the latter case they could be various stages in the granitization of the older rocks.

These zones of enclaves show a regional parallelism to the strike of Dharwars. The granitic rocks with their numerous enclaves may be the result of transformation of pre-existing rocks without large-scale magmatic intrusion. Possibly these basic enclaves could



FIG. 1

(Fig. 1) and faulting on a small scale. They are mainly composed of hornblende, biotite and accessory quartz and felspar. Associated with these enclaves are numerous small pegmatites,

FIG. 2

also be explained as due to concentration of the mafic elements along certain zones during the main mass granite itself, i.e., some sort of a small-scale basic front.

The author desires to express his grateful thanks to Dr. S. Balakrishna for his guidance.

Geology Department,
Osmania University,
Hyderabad, February 27, 1959.

N. RAJA.

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ELASTIC WAVE VELOCITIES IN MAKRANA MARBLES

DURING a detailed investigation, it has been observed by the author,¹ that the transmission of ultrasonic waves in monomineralic rocks like quartzites and limestones depends upon the particle size and texture. It has been found that in coarse-grained rocks, the velocities are low and absorption high whereas in fine-grained rocks, the velocities are high and absorption low. Marbles from Makrana (Rajasthan) belonging to the same lithological division (metamorphic) are chosen in this investigation for studying the relation between particle size and texture and the elastic wave velocities. The ultrasonic velocities, longitudinal (V_L) and torsional (V_T), have been measured employing the total internal reflection method described by Krishnamurthi and Balakrishna.² The results in km./sec. are given in Table I.

TABLE I

No.	Colour	Density gm./c.c.	Grain size	V_L	V_T
1	Baroda green	2.69	Fine	7.30	2.70
2	Flowery grey	2.74	Medium	7.05	2.64
3	White	2.74	Coarse	6.78	2.59
4	Light pink	2.77	Very coarse	6.78	2.51
5	Chocolate	2.72	Fine	7.11	2.66
6	Black	2.90	Medium	6.99	2.56
7	Sea grey	2.75	Coarse	6.53	2.50
8	Yellow	2.47	Coarse (Oolitic)	6.42	2.29

The velocity values and the grain size, as revealed by microscopic studies given in Table I, show that the velocity decreases as grain size increases. Further it is also noticed in this series as in previous ones, that absorption is high in coarse-grained rocks while it is low in the fine-grained rocks.

Geology Department,
Osmania University,
Hyderabad, June 1, 1959.

S. BALAKRISHNA.

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FOSSIL THALLOPHYTES FROM MOHGAON-KALAN LOCALITY CHHINDWARA DISTRICT, M.P.

FOSSIL FUNGUS

OUR knowledge of Rust fungi from the Intertrappean beds of Madhya Pradesh, which otherwise are copiously rich in fossil flora, is fairly meagre. Only some types belonging to a few groups other than the Rust fungi have been recorded of which *Palæosordaria* and *Perisporiacites* Sahni & Rao² are quite well preserved.

Mrs. Chitaley¹ recorded some zygospores which could be traced to Mucorales. Late Prof. Sahni (1943)³ for the first time recorded septate mycelia in the seed-coat of the fruit *Enigmocarpon* and the material recorded in the present paper is a further contribution in the same direction.

The present paper deals with a new type of Rust fungus infecting the fruit *Enigmocarpon Parijai* Sahni. The fungus appears in the form of fungal cups or sori just below the epidermal layer of the fruit (Figs. 1, 2 & 3). The cups are either open or closed, a fact obviously due to a slightly oblique plane through which the cups have been cut. Most of the cups vary in size and are empty while others show either bicelled teleutospores or septate mycelia, or both spores as well as mycelium. Hyphae are septate, closely packed and profusely branched. In several cups mycelium is meagre and the bicelled spores are seen lying *in situ*.

The spores are either in groups or isolated. Where in groups they appear to have been seen held together by some gelatinous substance.

The present fossil fungus seems to be in the Teliospore stage and not a single uredospore is found inside the sori. Comparisons of this fungus have been made with the living genus *Puccinia* on wheat and *Gymnosporangium*.

All the above facts lead to the evidence that this genus belonged to Basidiomycetes and was in the last stage of producing the teliospores.

No such genus of Rust fungi has been reported so far from these beds of Deccan Intertrappean series, Madhya Pradesh, which is now believed to be Eocene. Therefore it is proposed to assign it to a new genus *Shuklania*. A detailed paper will be published later.

FOSSIL ALGA

The present discovery of the fossil alga is another unique finding from the same locality. It is another significant report since the discovery of *Spirogyrites* from the same bed by

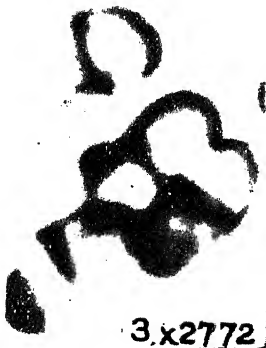
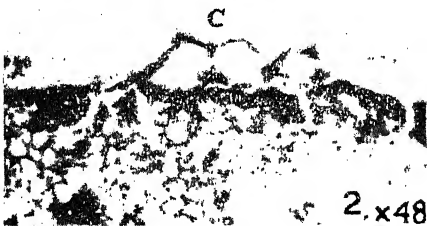


FIG. 1. Transverse section of the fruit *Enigmocarpon* showing fungal cups (c).

FIG. 2. A portion of fruit wall with three empty fungal cups (c).

FIG. 3. A few teleutospores highly magnified.

Shukla.⁴ Maceration with the help of Hydrofluoric acid was carried out and an excellently preserved, though fragmentary, algal filament was obtained. The fossilised alga shows three oogonial mother cells in a series with numerous dwarf males of normal and abnormal type attached on both sides of these (Fig. 4). The reticulate arrangement of the chloroplast strands (strands more or less parallel with each other) and a distinct nucleus inside one of the oogonial mother cell has been noted.



FIG. 4. Fragmentary alga with three oogonial mother cells and dwarf males attached to them.

The fossil alga resembles the freshwater alga *Oedogonium* in most of its characters, thus getting a natural position in the class—Chlorophyta, order—Oedogoniales, family—Oedogoniaceae. It is proposed to call it *Oedogonites*, suggesting its resemblance with the living genus *Oedogonium*. The detailed paper will be published later.

Tilak Dhari College,
Jaunpur (U.P.),
January 12, 1959.

J. N. DWIVEDI.

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BIONOMICS OF SOME PREDACIOUS COCCINELLID BEETLES OF THE PANJAB

THE present note records some observations made on some of the available predacious beetles in the Panjab during 1950 and 1951, to study their bionomics, seasonal history, host-predator relationship and their relative efficacy in controlling some of the reputed pests.

Their life-history and feeding habits were studied in small Laboratory cages in which the shoots of growing potted plants, infested with different pests were introduced to provide food to the predators under practically natural condition. In *Menochilus sexmaculata* the precopulation period extended from a few hours to three days and similarly the preoviposition period lasted from 1-3 days. Only one copulation was sufficient to ensure fertility. The maximum number of eggs laid by a female of this species was 654 with an average of 16 eggs per day. The incubation period varied from 2-5 days during the active season and about 20 days during winter. The larval stage extended from 4-22 days and the average daily consumption of the larva ranged from 19.2 to 27.6 aphids. The pupal stage was 2-6 days during the active period but extended to 30 days in winter. The entire life-cycle, during the active period, ranged from 9-33 days. On an average, an adult consumed 84.7 aphids per day. The maximum daily consumption of 161.3 aphids was observed in the case of the adults of *Coccinella septumpunctata* and of 93.6 aphids by the larva of *Leis dimidiata*. In *Catana parcesetosa* the predator on white-flies, the egg stage, on an average, was 4 days, larval stage 6 days and pupal stage 4 days. The total life-cycle in summer occupied 14 days.

Hatching of parthenogenetic eggs of *Menochilus sexmaculata* Forbes and *Coccinella septumpunctata* Linn. was observed in a few cases which is probably a new record. Some information was also collected on the artificial feeding which revealed that in captivity *Menochilus sexmaculata* Forbes and *Catana parcesetosa* Sicard may survive on artificial food as honey or glucose syrup for a period of 15-20 days, while those starved, died within 3 days. The beetles fed artificially copulated frequently but did not lay any egg.

Of the 22 species of predacious Coccinellids recorded on aphids, white-flies, psyllids, mites, thrips and mildew fungi, four species, namely, *Leis dimidiata* Forbes, *Anisolamnia dilatata* Forbes and two species of *Caelophora*, were

obtained from the mountainous and sub-mountainous regions preying upon aphids and the remaining species were collected from the plains.

As regards the host-predator relationship three species, viz., *Coccinella septumpunctata* Linn., *Adonia variegata* Goeze and *Scymnus quadrillum* Motschulsky, were exclusively aphidivorous while *Brumus suturalis* Forbes and *Exochomus flavipes* Er., though primarily aphidivorous, have also been observed feeding on white-fly (*Bemisia tabacci*) and psyllids. *Scymnus* sp. was observed as a specific predator on the aphids on "Mehndi" plants (*Lawsonia alba*). The species *Catana parcesetosa* Sicard, *Pharoscymnus flexibilis* Mulsant, and *Scymnus xerampelinus* Mulsant were exclusively the predators on white-flies. The species, *Chilocorus nigritus* Forbes and *Scymnus coccivora* Ramakrishna, were recorded on scale insects whereas *Stethorus gilvifrons* Mulsant and *Scymnus-o-nigrum* Mulsant preyed on mites and thrips respectively and finally *Thea cincta* Forbes and *Thea bisoctonotata* Mulsant were noticed feeding only on fungi.

When the predators appeared almost simultaneously with the pest and the conditions were favourable for multiplication, the predators brought the pest under control within a couple of weeks. This was particularly noticed in the case of attack on Lucerne, brinjal, bottle gourd, potatoes, marigold, "Mehndi" (*Lawsonia alba*) and the hedge plant (*Cryptostagia grandiflora*). On the other hand, when the predators appeared late or their multiplication was slow, they failed to control the pest as noticed in the case of aphid infesting gram (*Cicer arietinum*) and tobacco.

Some new findings during these investigations were (I) hatching of parthenogenetic eggs in *Menochilus sexmaculata* and *Coccinella septumpunctata*, (II) preying of *Catana parcesetosa*, *Pharoscymnus flexibilis* and *Exochomus flavipes* on white-flies, (III) *Scymnus-o-nigrum* feeding on thrips, (IV) Copulation in *Menochilus sexmaculata* as a result of artificial feeding, (V) feeding of the predators *Coccinella* and *Menochilus* species on mulberry fruits during aphid scarcity and (VI) association of some smaller Coccinellids with spider webs.

The authors are indebted to Dr. A. P. Kapur of the Zoological Survey of India, Calcutta, for identifying the material and giving useful suggestions connected with the problem. They are also grateful to the Director of the Indian Agricultural Research Institute, New Delhi, and

the Head of the Division of Entomology for kindly allowing the necessary facilities at the institute during the course of these investigations.

Zoology Department,
Panjab University,
Hoshiarpur (Panjab),
August 26, 1958.

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C. P. MALHOTRA.

A NOTE ON THE CORRECT ZOOLOGICAL NAME OF THE INDIAN LITTLE GREEN HERON (AVES, ARDEIDAE)

It is customary to place the Indian little green heron from India, Pakistan, Nepal, Burma and Ceylon in the same subspecies as the Javan bird (Jerdon, 1877; Murray, 1890; Sharpe, 1898; Blanford, 1898; Baker, 1929; Peters, 1931), which is now known as *Butorides striatus javanicus* (Horsfield). But a comparison of the Indian and Javan material reveals marked difference between them. The Indian bird is distinctly paler in coloration, and has longer moustachial streak, and longer wing (18 ♂ 174-184 mm., 6 ♀ : 177-182 mm., 3 unsexed : 179-182 mm. versus 3 ♂ : 165-174 mm., 2 ♀ : 166-174 mm.). It thus appears necessary to place the Indian bird in a subspecies different from the Javan.

The earliest name used for the Indian bird, namely, *Egretta chloriceps* v. *virescens* Auct. by Hodgson (1844), is *nomen nudum*, as also the same name cited as a synonym of *Ardetta javanica* by Gray and Gray (1846). The oldest valid name appears to be *Ardea chloriceps* Bonaparte (1857), with Nepal as the type locality. The Indian little green heron should, therefore, be known as *Butorides striatus chloriceps* (Bonaparte), and its type locality may be restricted to Hitaura, Chisapani Garhi Province, Nepal.

Furthermore, it seems that a thorough study of the intraspecific geographic variations in *Butorides striatus* would yield interesting information necessitating recognition of additional subspecies especially for the populations of North Burma-Yunnan-Viet Nam area.

I am thankful to the authorities of the American Museum of Natural History, New York, for granting me facilities to study their collection on which the observation presented above are based.

Zoological Survey of India, BISWAMOY BISWAS.
Indian Museum,
Calcutta-13,
March 4, 1959.

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A SIMPLE UNFORTIFIED RICE MEDIUM FOR MASS-REARING OF THE MELON FRUIT-FLY, *DACUS* *CUCURBITAE* COQUILLET UNDER LABORATORY CONDITIONS

For investigations on experimental biology and fruit-fly control including physiological and toxicological studies, a large supply of test insects of a uniform stock is necessary. The present note gives a suitable technique employing simpler and cheaper food medium for mass breeding of the melon fruit-fly.

Finney (1956) and Christenson *et al.* (1956) described seminatural food media (carrot) for successful mass breeding of *Dacus dorsalis* and other flies but their methods require provisions for storing large quantities of fresh plant material under cold storage conditions for use in off-season periods and for addition of extra nutrient in the form of yeast. Moreover the carrot when used for *D. cucurbitae* deteriorated too soon and adversely affected larval vigour and development. The unsuitability of carrot for this species has also been recorded by Finney (1956).

Out of a number of materials tried, rice was found most suitable. To 25 gm. of finely powdered rice was added 100 ml. of water and

the mixture was boiled with frequent stirring, to form a thick paste. On cooling it attained a suitable consistency which provided an ideal physical condition to the medium for larval development. Small enamel trays of the size 8.5" x 6.5" x 2" containing $\frac{3}{4}$ " thick food layer were found suitable for rearing. A large number of eggs or newly hatched larvae were directly put on the food which was then covered with thin layer of moist cotton to prevent undue loss of water. The trays were covered with fine muslin and kept at suitable temperature. Addition of yeast as extra nutrition source or acid to lower the pH was not necessary.

The maggots when full-grown were removed for pupation in a jar containing sand. After 3 days the sand was sifted to recover pupae to be kept in oviposition chambers. The adult flies when emerged were offered hydrolysed protein, sugar and water to ensure proper ovarian development and oviposition of viable eggs.

The performance of the medium was satisfactory as observed by the fact that 80% larvae pupated and flies were normal in their vigour and general behaviour. The total period from egg to emergence of adult took 12-15 days at 26-29° C.

This medium is now being used for routine large-scale rearing of *D. cucurbitae* in this laboratory and is preferred over all other food media because of its low price, easy availability and simple procedures involved in its formulation.

The authors wish to thank Dr. E. S. Narayanan, Head of the Division of Entomology, for his keen interest in the work and for according necessary laboratory facilities. Thanks are due to Dr. B. P. Pal, the Director of the Institute, for permitting the publication of the results.

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Division of Entomology, N. C. PANT,
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New Delhi 12, S. S. CHAWLA.
February 27, 1959.

ON THE AMINO-ACID NITROGEN CONTENT OF CANE JUICES

SEVERAL investigators report^{1,2} having encountered leucine, asparagine, glycocol and similar bodies in the cane juice. Zerbani¹ isolated asparagine, glutamine and tryptophan from cane juices. The amino-acid content in cane juice influences to a certain extent the colour of jaggery produced from it. For this reason, it was thought worthwhile to determine the quantities of amino-acids present in certain improved cane varieties newly evolved at Coimbatore.

For estimation the colorimetric method involving the use of β -naphthoquinone sulphonic acid as used by O. Polin² for the determination of amino-acid nitrogen in blood and urine was tried and was found satisfactory. The procedure for estimation and the results are reported below:—

Centrifuged fresh cane juice (5 ml.) was made up to 100 ml. and 25 ml. of the diluted juice were further diluted to 100 ml. 5-10 ml. of this diluted juice were freed from proteins (using sodium tungstate and sulphuric acid) and the filtrate made up to 25 ml. To suitable aliquots (found by trial and error) from the protein-free filtrate, a drop of phenolphthalein and sodium carbonate (0.2354 N) were added till the colour matched approximately with the standard or standards containing known amounts of glycine, phenolphthalein and sodium carbonate. After diluting to 10 ml., β -naphthoquinone sulphonic acid (0.5%), 2 ml. to the standard and 1 ml. to the sample were added (N.B. If the standard and sample differ much in colour after 15 minutes, the experiment is to be repeated taking suitable concentration). After 20-30 hours, 2 ml. of acetate mixture containing 1 volume of 50% acetic acid and 1 volume of 5% sodium acetate solution and 2 ml. of 4% $\text{Na}_2\text{S}_2\text{O}_3$ solution were added to the standard and 1 ml. of each of the acetate mixture and hypo were added to the sample in the same order. The standard and sample were diluted to 50 ml. and 25 ml. respectively and the colour compared in an Utilix Colorimeter. The weight in milligrams of glycine representing the amino-acid nitrogen per 100 ml. of juice divided by the sp.gr. of the juice gives the weight in milligrams per 100 g. of juice.

In these estimations, juice sample was taken from that obtained by crushing 50-60 fully mature canes grown under similar agronomical conditions. In Table I are given, the amounts

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2. Finney, G. L., *ibid.*, 1956, **49** (1), 137.

in milligrams of amino-acid nitrogen (in terms of glycine) on juice weight basis.

TABLE I

Amount in milligrams of amino-acid nitrogen expressed as glycine per 100 g. of juice

Variety	D ₁		D ₂		Mean
	<i>l</i> ₁	<i>l</i> ₂	<i>l</i> ₁	<i>l</i> ₂	
Co. 1243 ..	15	15	14	16	15
Co. 1251 ..	58	57	61	61	59
Co. 1252 ..	48	48	45	42	46
Co. 1253 ..	40	44	..	..	42
Co. 1254 ..	33	33	32	34	33
Co. 1255 ..	51	51	50	53	51
Co. 1256 ..	43	43	42	44	43
Co. 1264 ..	36	37	39	35	37
Co. 1273 ..	43	47	44	47	45

D₁ and D₂ are dilutions and *l*₁ and *l*₂ are levels for each dilution; 4-6 readings taken per dilution.

It will be seen from Table I that the method gives fairly uniform results for two different dilutions at two levels. Also, considerable variation in the amino-acid nitrogen content among the varieties may be noted, the range being from 15 mg. in Co. 1244 to 59 mg. in Co. 1251. The varieties containing larger amounts of amino-acid nitrogen gave high value for the colour of the Gur obtained with controlled addition of lime, adjusting the pH to 6.5-6.7.

Thanks are due to Shri N. L. Dutt, the then Director and Dr. N. R. Bhat, Director, Sugarcane Breeding Institute, Coimbatore, for affording all facilities.

Sugarcane Breeding Inst.

Coimbatore,

February 2, 1959.

K. CHIRANJIVI RAO.

K. V. GOPALA AIYAR.

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EFFECT OF TRACE ELEMENTS ON SEEDLING MORPHOGENESIS IN ARACHIS HYPOGAEA LINN.

In a previous communication¹ seedling morphogenesis was reported in a spreading variety groundnut, TMV. 3, following seed treatment with aqueous extract of seeds of a non-dormant bunch variety groundnut TMV. 2. The occurrence of seedling morphogenesis in

the bunch variety groundnut TMV. 2 due to treatment of seeds with trace element salt solutions, is reported here.

The observations made (Fig. 1) consisted of reduced growth of shoot and primary root,

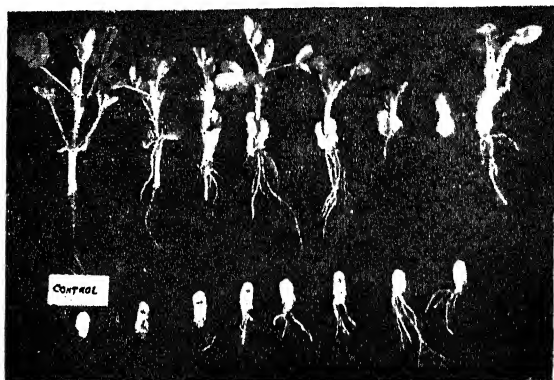


FIG. 1. Seedling morphogenesis in *A. hypogaea* Linn. Top row: Seedling variations. Bottom row: Cotyledon variations. Figures to the extreme left are normal, seedling and cotyledon.

shortening and swelling of hypocotyls producing adventitious roots. Besides this proliferative growth appeared on the bases of the cotyledons: roots, many fasciated, emerged from cotyledon proliferations as well as from these of the hypocotyl. There was also a tendency for the cotyledons to get themselves separated from the main axis due to emergence of fasciated roots from the adaxil side.

The observations recorded above were made in a preliminary germination study wherein the seeds were soaked in solutions of CuSO₄, MnSO₄, ZnSO₄, and H₃BO₃ for a period of 16 hours, keeping the ratio of seed weight to solution at 3:1 in order to ensure that the solution was completely absorbed by the seed: a concentration of 200 p.p.m. of the individual trace elements was used. Among seedlings from any given treatment the morphogenic effects observed were similar without any qualitative or quantitative variations.

A similar study was undertaken with spreading groundnut varieties, viz., TMV. 1 and TMV. 3 using same trace elements at same concentrations, in order to find out whether morphogenic effects were induced. In seedlings from trace element treatments none of the abnormal growth as observed in the case of the bunch variety appeared. Although the trace elements inhibited germination, their only unfavourable effect on seedling morphology was slowed development. Otherwise the seedlings were quite normal,

The difference in physiological behaviour of the two agronomic forms of groundnut, viz., the bunch and spreading are highly interesting. Crane and Bradley² have recognized two biological systems in a germinating seed, one governing the process of germination and the other influencing the mechanism of native auxin formation. It is likely that the trace elements used would have influenced the system governing the native auxin formation in the case of the bunch variety groundnut resulting in the production of more auxin which brings about root formation and other abnormalities. It has already been reported¹ that the seeds of the bunch variety groundnut TMV. 2 possess a water-soluble auxin-like substance capable of inducing roots. The observations recorded in this note may indicate the necessity for taking great caution in nutritional studies especially while using the physiologically active bunch variety groundnut TMV. 2 as a material.

The authors wish to thank Sri. T. R. Narayanan, Professor of Plant Genetics of the Regional Post-Graduate Training Centre, Coimbatore, for his help in preparing this note. Agricultural College and S. S. NAGARAJAN.

Research Institute, S. G. ATYADURAI.
Oilseeds Section,
Coimbatore-3,
February 12, 1959.

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THE SECOND THORACIC SPIRACLE IN APIS (HYMENOPTERA-APIDAE)

BETTS¹ (1922) drew attention to the gastral spiracular muscles of the Honey bee while Snodgrass² (1956) and Wohlgemuth³ (1929) have described the anatomy of the spiracles and the closing mechanism in detail, and Morison (1928) has studied the muscles of the adult bee. According to the above authors, the second thoracic spiracle is devoid of any closing mechanism and associated muscles. Snodgrass² (1956) observes that the spiracle is a simple minute aperture, without any closing device and difficult to find in old bees. Examination of the corresponding spiracles of the Oriental species, *Apis indica* Fab., *A. florea* Fab. and *A. dorsata* Fab., has revealed sufficient interesting detail to warrant a full preliminary description. The terminology employed is that of Tonapi (1958). The following Table gives

the details of the measurements of the posterior thoracic spiracle with its associated structures in four different species of *Apis*.

TABLE I

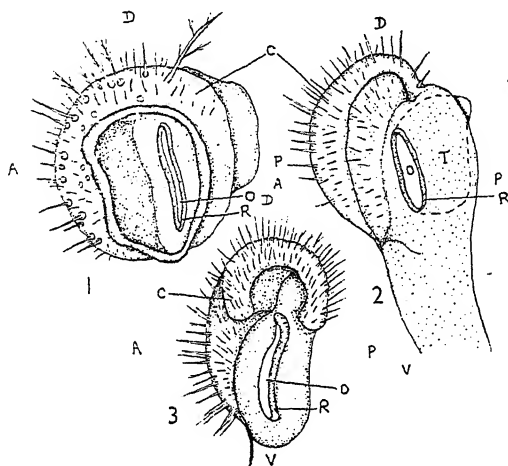
Species	No. Examined	Spiracular opening (Peritreme) Length × Breadth (mm.)	Collar Length × Breadth (mm.)
<i>A. indica</i> ♀	10	·12 × ·05	·22 × ·17
<i>A. indica</i> ♂	8	·12 × ·04	·24 × ·18
<i>A. indica</i> ♀	6	·1 × ·03	·18 × ·11
<i>A. florea</i> ♀	15	·09 × ·05	·15 × ·11
<i>A. florea</i> ♂	12	·08 × ·04	·18 × ·16
<i>A. florea</i> ♀	6	·08 × ·04	·14 × ·12
<i>A. dorsata</i> ♂	18	·12 × ·04	·16 × ·12
<i>A. dorsata</i> ♀	12	·12 × ·04	·15 × ·11
<i>A. mellifera</i> L. ♀	50	·14 × ·04	No collar (plate) ·11 × ·07

Apis indica ♀.—The spiracle is situated in the membrane of the upper ends of the mesepimeron and metapleuron. The postero-dorsal corner of the mesepimeron forms a semicircular notch. The collar surrounds the peritreme which is roughly circular and irregularly thickened. The peritreme leads to an atrium whose walls gradually become membranous and are fused with the tracheal opening. From the anterior side of the atrial wall arises a strongly sclerotised and curved calliper which embraces the tracheal opening. In the drones the collar remains on the anterior side and partially encircles the spiracle. In the queens of this species the spiracle is completely surrounded by the collar and the peritreme is situated in the spiracular depression (Fig. 1).

Apis florea ♀.—These are the smallest meta-thoracic spiracles of the species studied but are easier to locate as they are situated on the pubescent postero-dorsal corner of the mesepimeron. The peritreme is an angular elliptical rim-like structure posterior to the spiracular collar and leads into a spacious atrium which broadens inside (Fig. 2). To the base of the atrium is an elongate elastic ring with a small plate-like projection. In the drones and queens examined the peritreme is roughly oval in outline and the dorsal side of the atrium is produced into a beak.

Apis dorsata ♀.—The collar is well defined and conspicuous. It is sclerotised strongly but less thickened centrally. Below it lies the true

spiracular opening, around which is the roughly elliptical peritreme. Its dorsal and ventral ends are bent giving it a sigmoid appearance. The peritreme is thickened uniformly and leads into a chamber whose anterior wall is fused with the infolded membrane and posterior wall is heavily sclerotised. A sclerotised ridge runs from the posterior margin of the atrium and encircles round the tracheal mouth. A few drones were also examined. The collar forms an arch on the dorsal side and embraces the anterior side of the spiracle. It is comparatively large and more hairy (Fig. 3).



FIGS. 1-3. Fig. 1. External view of the second thoracic spiracle of the queen of *Apis indica*. Fig. 2. External view of the second thoracic spiracle of the worker of *Apis florea*. Fig. 3. External view of the second thoracic spiracle of the male of *Apis dorsata*.

A = anterior;	P = posterior;
D = dorsal;	V = ventral;
C = collar;	O = spiracular opening;
R = peritreme;	T = atrium.

Apis mellifera ♀.—After removing the hair the spiracular opening is partially visible externally. It is set in the infolded membrane of the upper ends of the mesepimeron and metapleuron. The anterior wall of the spiracle is attached to a sclerotised plate which has rows of hairs pointing outwards and could thus serve as an efficient filter mechanism. The peritreme is elliptical with its dorsal and anterior walls heavily sclerotised whereas the posterior and ventral walls are less heavily thickened. It is strongly compressed along its axis. A single trachea leaves the spiracle. Between the trachea and the peritreme is a small space bounded by a thin membranous

wall, at the base of which is an elastic tendinous ring. Wohlegmuth³ (1929) thinks that due to the peculiar position of the spiracle its closure is brought about by the compression of the sclerites. Mention may, however, be made that tracheal constriction is brought about by a mechanism other than a mere compression of sclerites.

Further study on their occluding mechanisms together with their synchronous role in the ventilative rhythm constitutes the subject of next report.

Acknowledgements are due to the Ministry of Education, Government of India, for the award of National Research Fellowship, during the tenure of which this work is now being completed. I am also indebted to the Director, M.A.C.S. Laboratory, for extending the necessary facilities. The bees were provided through the kindness of Shri K. V. Tonapi of the Apicultural Laboratory, Mahabaleshwar.

M.A.C.S. Laboratory,
Law College Buildings,
Poona-4,
January 13, 1959.

G. T. TONAPI.

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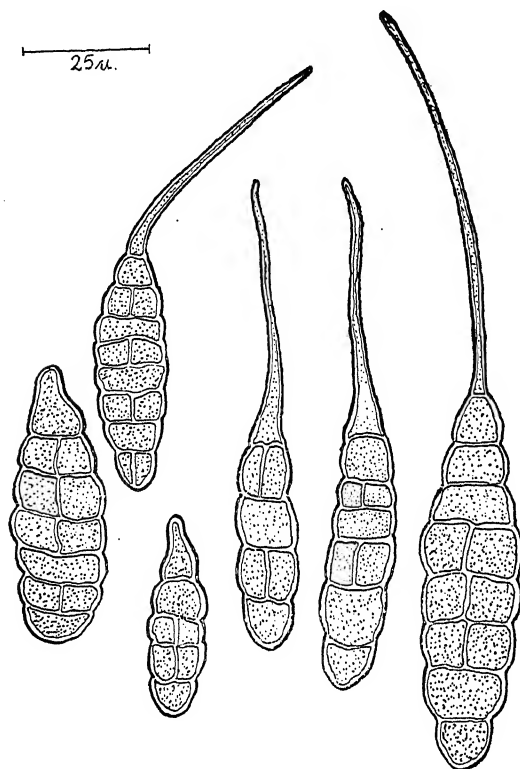
AGERATUM CONYZOIDES LINN., A NEW HOST FOR ALTERNARIA ZINNIAE PAPE

Ageratum conyzoides Linn., belonging to the family Compositae, is a common weed of the fields. These plants growing wild close to a tomato field in the Adhartal area, Jabalpur, were noticed severely affected by leaf blight towards the end of November, 1958. The disease could start from any part of the leaf but more often it was marginal. The lesions were dark brown to black and in advanced stages the affected leaves gave a burnt appearance and withered away.

Examination of the lesions revealed the pathogen to be an *Alternaria*.

Conidiophores are brown, septate, erect, with geniculations in the apical part, showing a few scars representing the point of attachment of the conidia. Conidia (Fig.) yellowish brown, fusoid to cylindrical, with 3 to 12 transverse septa (usually 7 septate), 1 to 4 longitudinal

septa measure $33-170.5 \times 6.5-23 \mu$, average $105 \times 15 \mu$, epispore smooth, at times a prominent scar at the basal end, borne singly, beaked and also beakless, beak abruptly starting from the apical end, lighter coloured than the spore body or concolorous, straight, unbranched, nonseptate to septate, 1 to 4 septa, filiform, with rounded ends, measured $16-105 \times 1.5-3.2 \mu$, average $60 \times 3 \mu$.



Spores of *Alternaria zinniae* [from Herbarium specimen.

The fungus has been identified from the literature as *Alternaria zinniae* Pape. The description of the fungus was sent to Dr. Paul Neergaard of Denmark and he also suggested it to be the same species.

However, Neergaard¹ has seen *Alternaria porri* f. sp. *solani* sometimes on *Ageratum houstonianum* and has carried out infection experiments with this form on *Ageratum* with positive results. This drew our attention to the closely growing tomato crop which was affected with leaf blight due to *Alternaria porri* f. sp. *solani* and it necessitated to find out if there was any relation in the infection of one on the other.

Cross inoculations with the two *Alternarias*

on tomato and *Ageratum conyzoides*, however gave negative results, whereas the direct ones were successful. Infection experiments with *Ageratum Alternaria* on *Tagetes erecta* (Marigold) and a *Cosmos* sp. gave positive results. Leaf blight of *Tagetes erecta* is known (Edward²) to be caused by *Alternaria zinniae*.

The present note is the first record of *Alternaria zinniae* Pape on *Ageratum conyzoides* Linn.

We are grateful to Dr. Paul Neergaard for his kind suggestions. Thanks are due to Prof. U. Mukerjee, Principal, Mahakoshal Mahavidyalaya, Jabalpur, for Laboratory facilities and to Miss S. Ganguli and Mr. R. Beliram for technical assistance.

Department of Botany, G. P. AGARWAL.
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Jabalpur,
January 2, 1959.

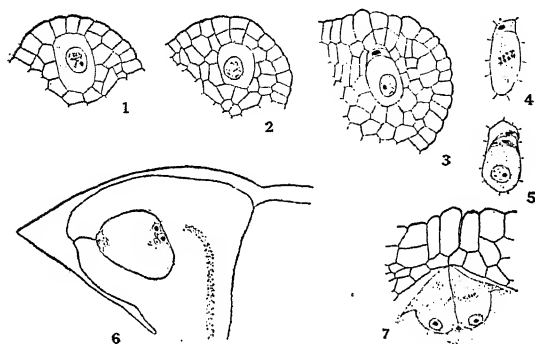
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OVULE AND EMBRYO-SAC OF *CRINUM LATIFOLIUM* L., A REINVESTIGATION

STENAR¹ described the ovules of *C. latifolium* to be devoid of integuments and considered the embryo-sac to be *probably* of the *Allium* type. Tomita² considered the ovules as anatropous and ategumentary and confirmed the *Allium* type of embryo-sac development. Dutt^{3a, 3b} showed the ovules of *C. deflexum* and *C. asiaticum* to be unitegmic and the embryo-sac develops according to the *Polygonum* type. Therefore, a critical reinvestigation of *C. latifolium* was undertaken and reported here.

There is a single hypodermal archesporial cell (Fig. 1) functioning as the megaspore mother cell without cutting off a parietal cell. Two nucellar epidermal cells above archesporium divide periclinally (Fig. 2). The megaspore mother cell undergoes the first meiotic division resulting in two dyad cells of which the upper degenerates (Fig. 3). The lower dyad cell undergoes the second meiotic division (Fig. 4) resulting in two megaspores situated below the disintegrating dyad cell. A row of three cells is thus formed, the uppermost being an undivided dyad cell. The lower megaspore is functional and becomes vacuolated (Fig. 5). In some cases the disintegrating upper megaspore is crushed earlier than the

dyad cell so that the dark patch above the functional megaspore may be mistaken for a disintegrating dyad cell.² However, it represents the disintegrating dyad cell as well as the upper megaspore. Three free nuclear divisions



FIGS. 1-7. Fig. 1. L.s. apical part of the ovule showing the archesporial cell, $\times 250$. Fig. 2. Same showing the periclinal division in two epidermal cells, $\times 250$. Fig. 3. Same showing the disintegration of the upper dyad cell, $\times 250$. Fig. 4. Dyad cells showing Meiosis II in the lower dyad cell, $\times 250$. Fig. 5. Triad showing the disintegration of the upper dyad cell and upper megaspore, $\times 250$. Fig. 6. L.s. ovule at the mature embryo-sac stage showing the hemitropous condition, $\times 40$. Fig. 7. L.s. apical part of the mature ovule showing the narrow micropyle and the egg apparatus, $\times 160$.

in the functional megaspore result in an 8-nucleate embryo-sac of the polygonum type. The eight nuclei organize themselves into the three-celled egg apparatus, three antipodal cells and two polar nuclei which fuse in the vicinity of the antipodal cells. The organized embryo sac resembles that of *C. deflexum* in essential respects. The curvature of the mature ovule does not justify calling it anatropous² but it can best be regarded as hemitropous (Fig. 6). The micropyle is extremely narrow (Fig. 7) and the ovule is unitegmis.

Thanks are due to Prof. S. Rangaswamy, Andhra University, Waltair, for material and to the Ministry of Education and Scientific Research, Government of India, for a grant-in-aid.

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OVULE STERILITY IN GRAM, *CICER ARIETINUM*

GRAM sterility, where the plants do not set pods, has been described earlier by Rao and Subramanyam (1934) and Singh and Radhey Shyam (1958). The authors during their studies of inheritance of a mutant named 'Bunchy' (in the cross T. 87 \times Bunchy mutant) observed in three F_3 progenies that in spite of good pod setting in all the plants certain plants in the population set seeds only in about 20% pods as against seed setting in about 90% pods in other plants. This complete lack of development of ovule in 80% pods on the plant and the parthenogenetic development of the pods is termed here as 'Ovule sterility'. All the ovules in a pod do not develop into seeds and the mortality of ovules has been described by Pal and Rao (1940).

The sterile plants were also found to have blue flowers instead of the normal pink flowers in other plants in the population and the parent. There seems to have occurred simultaneous mutation of pink flower colour to blue and of fertility to sterility.

The results of segregation in three F_3 progenies of the cross, T 87 \times Bunchy mutant are given in Table I.

TABLE I
Breeding behaviour of three F_3 progenies from
the cross T. 87 \times Bunchy mutant

Progeny	Segregation		Total	Chi-square 3 : 1	P value between
	Fertile pink flower	Ovule sterile blue flower			
1	100	27	127	0.9516	0.50-0.30
2	286	85	371	0.8629	0.50-0.30
3	27	10	37	0.0808	0.95-0.70

The data give a good fit to 3 : 1 ratio. Ovule sterility is therefore an inherited character and is a monogenic recessive. The blue flower colour which is completely associated with ovule sterility is also a simple recessive to pink flower colour. This complete association of blue flower colour and ovule sterility, however, does not appear to be always present, as a blue flowered mutant isolated by the senior author earlier did not have any such ovule sterility.

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The above results are confirmed by further studies of F_1 progenies of 10 selected F_2 plants.

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RADHEY SHYAM.

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A NOTE ON THE OCCURRENCE OF CERTAIN PARASITIC FUNGI ON INSECT PESTS OF SUGARCANE

CONTROL of insect pests by the use of natural enemies, i.e., parasites and predators, is a method which has been in vogue for some years past.¹ Biological control by the use of disease organisms, being economical, is easy and less hazardous and has proved efficacious and successful in the case of some insects, for example, the chinch bug, *Blissus leucopterus* (Say) in U.S.A.² Hence the control of insect pests by the use of disease organisms (parasitic fungi, bacteria and viruses) also seems possible.³

During the course of his association with the scheme for the control of beetle grubs at Dalmiaganja (Bihar), the senior author observed instances of mortality of some of the adult beetles of *Lachnosterna consanguinea* Blanch. (Scarabaeidae Melolonthinae), with no apparent symptoms of damage. However, in due course, the beetles developed fungal growth on their bodies and this condition could be induced with ease on fresh beetles by merely dusting and rubbing the fungus spores on the body wall of healthy beetles. The material was referred to Dr. E. A. Steinhaus of the University of California, Department of Insect Pathology, and the parasitic fungi were identified as (1) the green "muscardine fungus", *Metarrhizium anisoplae* (Metch.), and (2) *Beauveria bassiana* (Bals.). In the latter case the fruiting bodies arise on the exterior of the insect body forming a thick covering, thus

transforming the affected insects into white mummies.⁴ Subsequent field collections of the same beetle indicated the presence of yet another parasitic fungus, *Aspergillus parasiticus* Speare, which was also responsible for a heavy toll of the beetles.

Recently, while working with pests of sugarcane seedlings at Coimbatore, the senior author came across the fungus *Aspergillus parasiticus*, Speare,⁵ parasitizing mealy bugs (*Saccharicoccus sacchari*) and grasshoppers. The fungus could be cultured successfully in the laboratory. Repeated inoculation tests with all the three above-mentioned fungi gave heavy mortality of sugarcane pests such as *Saccharicoccus sacchari*, *Lachnosterna consanguinea* Blanch and grasshoppers, etc.

The authors are indebted to Dr. K. Ramakrishnan, Government Mycologist, Agricultural College and Research Institute, Coimbatore, for his valuable suggestions and help.

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A LEAF SPOT DISEASE OF *ANOGEISSUS LATIFOLIA* WALL., DUE TO *PESTALOTIOPSIS VERSICOLOR* (SPEG.) STEYAERT.

During August, 1958, plants of *Anogeissus latifolia*, which grows luxuriantly near the college, were found to be suffering from leaf-spot disease in an epiphytotic form. In some saplings hardly a leaf could be spotted which was not attacked. Diseased leaves of the above plants were also collected at the same time from Berhaghat, nearly 12 miles away. The causal organism has been identified as *Pestalotiopsis versicolor* (Speg.) Steyaert.

The disease first appears as pin-head spots, pinkish brown, on either surface from any part of the leaf. The spots increase and become circular to irregular in shape measuring up to 12 mm. in diameter. A number of spots may

coalesce and increase the diseased surface. The mature lesions are dark brown with the central region ash coloured in which become visible acervuli as black dots. They are more distinct on the upper surface of the leaf. The middle and the main veins are freely traversed. Lesions also extend to petioles.

The acervuli are subepidermal and the conidia are borne on small conidiophores. Conidia are 3-5 septate but mostly 4 septate. The central cells are deeply coloured while the two end cells are hyaline with a beak on one side and two to three cilia on the other side. The conidia measure $13-26 \times 3.3-6.5 \mu$, average $19 \times 4 \mu$. The length of the coloured part varied from 10 to 20μ , average being 13.8μ .

The fungus was isolated and single spore cultures were made. Infection experiments were carried on the wild growing plants in the field. Artificial inoculations were made on both the surfaces of the leaves in the injured as well as uninjured conditions. The inocula consisted of small masses of mycelium mixed with spores. In some cases moist cotton pads were kept over the inoculated region.

It was noticed that the infection appeared within 3 to 4 days in all the cases. The fungus appears to be a strong parasite because the injured as well as the uninjured leaves were attacked on both the surfaces. Moisture seemed to favour an early infection and the fast spread of the disease.

Some infected leaves showing the presence of black dot-like acervuli, were tied with healthy leaves and sterilized water was sprayed over them. It was found that healthy leaves got infected due to contact with the diseased ones.

Cross-inoculations with *Pestalotiopsis versicolor* on *Punica granatum* L. and *Mangifera indica* L. showed negative results whereas on *Psidium guajava* L. and *Carissa carandas* L. it was successful. *P. versicolor* has been reported on leaves of *Carissa* sp. from Karwar in Bombay (Ramakrishnan and Subramanian).¹

The fungus was grown on different nutrient media. The size of the conidia on potato-glucose agar medium was $23-43 \times 3.3-6.5 \mu$, average $27 \times 6 \mu$. The length of the coloured part ranged from 10 to 33μ and the average was 18μ . The size of the spores on different nutrient media appeared to be quite uniform. However, the spores on the host in nature are smaller in size than those from the culture.

Review of the literature shows that so far there is no record of *Pestalotiopsis* on *Anogeissus latifolia*. The present note is a

record of the same from Madhya Pradesh, India. The specimen and the culture have been deposited in the Herbaria of the Commonwealth Mycological Institute, Kew, England, and the Botany Department, Mahakoshal Mahavidyalaya, Jabalpur.

The authors express their grateful thanks to the Director and to Dr. M. B. Ellis of the Commonwealth Mycological Institute, Kew, for the kind identification of the causal fungus. Thanks are also due to the Principal and the Head of the Botany Department, Mahakoshal Mahavidyalaya, Jabalpur, for Laboratory facilities, to Miss V. Bhawe and Mr. R. Beliram for technical assistance and to the University of Jabalpur for sanctioning a Research Grant to the senior author for investigating the parasitic fungi of Jabalpur.

Department of Botany, G. P. AGARWAL.
Mahakoshal Mahavidyalaya, (Miss) S. GANGULI.
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AN AGAR-CUP METHOD FOR DETECTION OF MICROBIOLOGICAL OXIDATION OF IRON IN SOIL

THE possibility of microbiological oxidation of manganese in soil has been demonstrated by many workers. Gerretsen¹ devised an ingenious technique and investigated the biological oxidation of manganese in soil and its probable role in inducing manganese deficiency in soils.

Similarly, oxidation of iron also is a commonly occurring phenomenon and many workers have pointed out its importance. Colmer *et al.*² isolated a bacterium from acid mine drainage of some bituminous coal mines which could bring about rapid oxidation of the ferrous iron in the drainage to ferric iron. Gleen,³ making use of the soil-perfusion apparatus, tried to study this phenomenon.

An attempt was made here to see whether iron-oxidation can be proved along the same lines as manganese oxidation. The technique used was essentially that of Gerretsen (*loc. cit.*) with slight modifications.

Ten grams of garden soil were mixed with 100 ml. of sterile water; 1 ml. of this suspension was mixed with 50 ml. of quickly cooled water-agar (2%) and poured into a petri dish (diam. 11 cm.). After the agar had solidified

well, a cavity of 1 cm. in diameter was made using a sterile cork-borer and filled with a suspension of agar containing 1% ferrous sulphate. After 20 to 24 hours' incubation at room temperature (32-35° C.), a clear yellowish brown diffusion ring of about 4 cm. in diameter was formed (Fig. 1). This brown ring showed

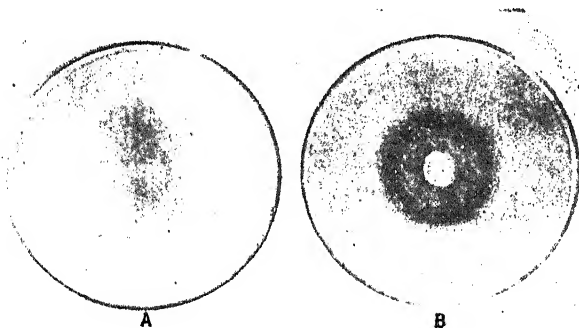


FIG. 1. Biological oxidation of iron in soil.

A. Agar-plate, without adding the soil suspension.
B. Agar-plate after adding the soil suspension. (Note the ring of oxidised iron.)

ferric iron when tested with potassium ferrocyanide.

Incubating the plate at 0° C. or mixing the soil agar suspension with chloroform prevented formation of the ring, thus clearly showing the primarily biological nature of the process.

The suitability of this method for more critical evaluation of the process is being further investigated.

I am deeply grateful to Prof. T. S. Sadasivan for help and guidance. I thank the Government of India for the award of a Senior Research Fellowship.

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NATURE OF DAMAGE CAUSED BY ERIOPHYID MITE IN SUGARCANE

RECENTLY, a species of mite, *Eriophyid* sp., forming gall-like blisters on the inner surface of leaf-sheaths of sugarcane has been reported.^{1,2} The damage caused by this mite is very characteristic and can be identified readily by the external leaf-sheath scars and deformed erineum and russet patches on the undersurface

known as "acarо-cccidi". Unlike the more complex type as that of frog hopper blight in sugarcane in which a distinct local lesion is followed by pronounced systemic effects, the traumatic injury caused by these mites is rather simple and is more confined to the neighbourhood of the actual damage. The large number of mites which congregate in a small area, with their piercing mouth parts rupture the epidermal cells on the inner side of the leaf-sheaths and also seem to ejaculate some toxins and excrete nitrogenous waste in the form of guanin, etc., with the result that the organisation within the affected tissues is greatly disrupted (Fig. 1).

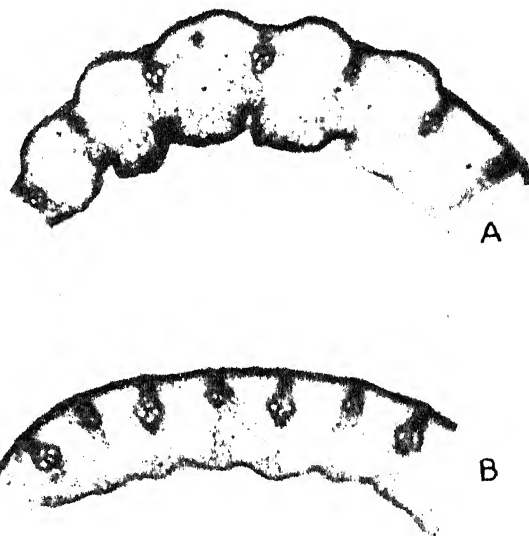


FIG. 1. A—T.S. damaged leaf-sheath.
B—T.S. healthy leaf-sheath.

Epidermal cells in the outer layer are largely flattened and destroyed. Both the parenchymatous matrix and vascular bundles are more or less equally affected. The derangement of the tissues manifests itself mainly by the changes in size and shape of the cells. Later saprophytic fungi such as *Alternaria* sp., *Glaesporium* sp. and *Fusarium* sp. obtain an early foothold on the necrotic areas caused by the feeding of these mites.

The authors are indebted to Dr. N. R. Bhat, Director, Sugarcane Breeding Institute, for his kind interest in these studies.

Sugarcane Breeding Inst., R. A. AGARWAL.

Coimbatore,

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UNIQUE SUPERIMPOSITION OF AXES IN CHICK EMBRYO CAUSED BY X-RAYS

THE experimental production of twins always throws light on the problem of the organisation of embryos. The organisation mechanism of chick embryos has recently been analysed by X-ray interference (Mookerjee and Bose, 1954). In the course of ionization experiments upon the chick blastoderm, an unusual case of double axes was encountered. This embryo is singularly peculiar for its unorthodox pattern of axiation, one axis being superimposed over the other (Fig. 1).

This double embryo resulted when 600 r of X-ray were given at the focal point of gastrulation of the blastoderm. It was available for study after 48 hr. of incubation and the following peculiarities were noticed at the middle region of the embryo as studied in transverse sections:—

1. Two axes, each comprised of a neural tube and a notochord, were superimposed one above the other. Each neural tube shows the perfect nature of induction as it is completely closed. The notochords are circular in outline.
2. A gut is conspicuously absent from both axes.
3. The somite of the right side of the top embryo has a big coelomic space. Similarly a loose space in the somite is also noticed on the right side of the lower embryo.



FIG. 1. The superimposition of two axes in a chick blastoderm caused by irradiation at 600 r.

Waddington (1952) advanced the view that twin formation in chick embryo is primarily a matter of atypical cell movements during gastrulation. This shifting of cells, according to him, in fact, carries the directive of the future induction pattern. In keeping with the view, various twins, occurring on the lateral sides of one of the primary axes can be interpreted. However, in the embryo described here, the twinning is noticed one above the other and not laterally. It is reasonable to advance that this type of induction may have

been caused not only by the abnormal cell movements but also by the reversibility of cell-fate. It may also be reasonable to assume, following the morphogenetic movements, the cells later probably differentiate into a new path contrary to their prospective fates, so as to eventually give rise to an unusual pattern of axis upon axis.

The writer is indebted to Dr. Sivatosh Mookerjee, Head of the Department of Zoology, Presidency College, Calcutta, for his guidance in this investigation.

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Calcutta, December 5, 1958.

ASOKE BOSE.

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A PRELIMINARY ACCOUNT OF EXTERNAL MORPHOLOGY OF THE WORKER AND ALATE OF *ODONTOTERMES OBESUS* (RAMBUR)

KUSHWAHA¹ has given a preliminary account of the external morphology of the soldier caste of the common mound-building termite, *Odontotermes obesus* (Rambur) (Isoptera, family Termitidae). A similar account is now noted for the remaining two castes, viz., worker and alate.

The head in both the workers and alates is hypognathous with mandibulate type of mouthparts. The paired compound eyes and ocelli are developed only in the alates. The antennae in the alates are 19-segmented and in the workers 17-segmented. The tentorium is stoutly built on the same plan as described in the soldier. The cervix of both the workers and alates closely resembles that of the soldier in its structure.

The thorax in alates is composed of a simple prothorax and a more complex wing-bearing prothorax. Characteristically the prothoracic pleuron lacks the alar elements, i.e., *axillaries*, associated with the prothoracic pleura for the wing-thorax joint. There are two pairs of wings which are divided by the *humeral suture* into the permanent *wing-scale* proximally and the temporary *lamina* distally. The *costal* and *sub-costal* veins of the wings are fused with the costal margin. There are two pairs of conspicuous thoracic *spiracles*. The three pairs of legs resemble that of the soldier in structure but differ in size, being much larger in alates.

in structure but differ in size, being much larger in alates.

The abdomen in alates is divided into 10 segments. Corresponding to the 10 segments, there are 10 tergites, but only 9 sternites. The first sternite is absent, as in soldier; only sterna 2-10 being present. In the females of alates the VII sternite is greatly developed. Both VIII and IX sternites have undergone reduction in size. The VIII sternite is split up into a pair of considerably reduced sclerites and situated outwards on either side of the IX sternite. The paired, narrow and linear sclerites adjacent to the anterior border of the IX sternite are the *basivalvulae*. In the males there is no marked modification in the VII, VIII and IX sternites, except that the last one is very narrow. A pair of unsegmented *sub-anal styles* are borne on the IX sternite of the males alone. The X sternite is represented in both the sexes by a pair of broad *podical plates* with unsegmented *anal cerci* located laterally. There are eight pairs of abdominal spiracles provided with *manubrium* in the alates.

The thorax and abdomen in the workers are almost similar to that in the soldier as regards the tergites, pleural sclerites, sternites, legs, spiracles and the terminal abdominal appendages in shape and size.

A fuller account is under publication.

My sincere thanks are due to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for his guidance and supervision during the progress of the work and for laboratory facilities at the Forest Research Institute, Dehra Dun, and Z.S.I., Calcutta.

K. S. KUSHWAHA.

Dept. of Zoology & Entomology,
Rajasthan College of Agriculture,
Udaipur, February 7, 1959.

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BASIC CHROMOSOME NUMBER OF PTERIS

SINCE Manton's¹ first authentic report of chromosome numbers in pteridophytes, there have been serious contributions on the subject both from the Northern and Southern hemispheres. Among the higher genera in Copeland's² Pteridaceae (from *Pteris* onwards) some of the genera, especially, *Adiantum*, *Cheilanthes*, *Pellaea* and *Pteris*, have been shown to be dibasic, and polyploid series are reported both on 29 and 30. So far as the genus *Pteris* is concerned majority of the species investigated to-date are based on 29

whereas the numbers based on 30 were reported first by Manton¹ in *Pteris cretica* var. *albolineata* Hk. ($n = 2n = c. 90$) and *P. cretica* L. (Uganda material, $n = 2n = c. 120$). Later in 1956 Vazart³ reported the presence of $n = 120$ in *P. cretica* var. *Ouwerradii*. It may, however, be pointed out that this taxon is a horticultural variety and is known to be apogamous since 1918.⁴ Brownlie⁵ is the third to indicate $n = c. 120$ in *P. tremula* R. Br. from New Zealand.

Critical studies on *Pteris cretica* var. *albolineata* Hk. on the material kept in cultivation in the Rosery and Gandhi Gardens, Meerut (N. India) have shown unequivocal counts of 87 'bivalents' (autobivalents, sensu Håkansson and Levan⁶) at meiosis (Fig. 1) and



FIG. 1. Late diakinesis in a spore mother cell of 8-celled sporangium in *Pteris cretica* var. *albolineata* Hk. showing ' n ' 87, $\times 1,100$.

87 chromosomes in archesporial mitosis. Furthermore, observations on Himalayan samples of *P. cretica* L. and its close relatives especially *P. ensiformis* Burm., *P. dactylina* Hk., *P. pellucida* Pr., *P. stenophylla* Wall. and *P. multifida* Poir. have resulted only in numbers based on 29. The counts of $c. 120$ in Uganda taxon of *P. cretica*, *P. cretica* var. *Ouwerradii* and *P. tremula* (New Zealand taxon) need, therefore, a reinvestigation for the establishment of the base number 30. The possibility, however, seems little in view of the present observations together with Manton's¹ expression of the probability of numbers based on 29 for the two taxa reported by her to be possibly based on 30.

Evidently the genus *Pteris*, so far as the present knowledge is concerned, is monobasic

on 29. It would really be interesting, though not surprising, if unequivocal counts of numbers based on 30 are discovered in future investigations.

The writer is grateful to Prof. P. N. Mehra for help and encouragement and to Prof. V. Puri (Meerut) for laboratory facilities. He is thankful to Mr. G. E. Peuch for allowing to collect the material from his fern house (The Rosery) and to Mr. R. S. Pathania for the photomicrograph.

Department of Botany,
Panjab University,
Amritsar, February 27, 1959.

S. C. VERMA.

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BACTERICIDAL ACTION OF FORMALDEHYDE SOLUTIONS IN THE PRESENCE OF PEPTONE

THE results obtained by any method of standardisation of disinfectants and bactericides in the absence of organic matter are not of any practical value since most of the disinfectants are used in its presence. It is generally believed that the presence of organic matter vitiates the activity of most of the bactericides.¹ In the present investigation, the influence of nutritive organic matter like peptone on the bactericidal activity of formaldehyde solutions was studied.

The activity of 0.1 and 0.05 molar formaldehyde solutions was tested on *B. subtilis* spores in the presence of 1.0% solution of peptone at two different temperatures. The tubes containing the organism and the bactericidal solution in 1% peptone were kept at 37° C. \pm 1° and 25° C. \pm 0.5°. At the end of different time intervals, 1 ml. of the solution was withdrawn and 1 ml. of 10⁻² dilution was inoculated into each of 5 roll-tubes containing 5 ml. of molten nutrient agar maintained between 45 and 50° C. The tubes were rolled immediately under cold water and incubated at 37° C. for 48 hours and counted. The average of the quintuplicate platings was taken as the survivors at that time interval. The average percentage survivors of three such experiments were plotted against time and shown in Fig. 1.

The survivor/time curves were found to be discontinuous. In the case of 0.1 molar solution at 37° C. (curve A), about 60-70% of the

organisms were killed within 90 minutes and the remaining were killed after 180 minutes.

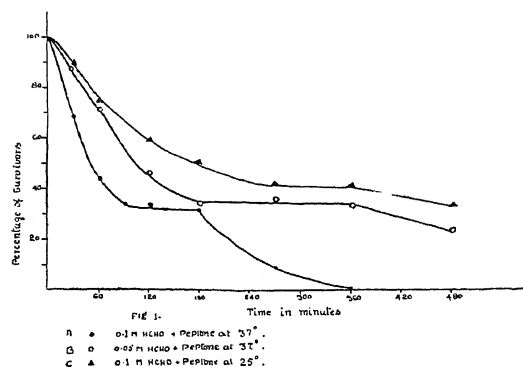


FIG. 1

During the 90-180 min. interval, no appreciable death seemed to occur. Such a period of inactivity (corresponding to the flat portions of the curves) was also noticed with 0.05 molar solution at 37° C. and 0.1 molar solution at 25° C. (curves B and C). A similar proportion of the organisms (30-40%) was found to survive during the period of inactivity but the survival periods were shifted from 90-180 min. interval to 180-360 min. interval. Prior incubation of peptone and formaldehyde at 37° C. for 3 hours before the addition of spores produced the same type of curve indicating that the discontinuous phase is not due to changes taking place between peptone and formaldehyde. But addition of formaldehyde after incubation of spores in peptone solution for 3 hours killed all the spores within 90 minutes. The spores were also found to lose their heat resistance during such incubation. Incubation of spores in nutrient solutions like broth and peptone for short periods were known to induce germination and such spores were found to lose their heat resistance.^{2,3}

From this study, it appears that the discontinuous phase in the above survivor/time curves might be due to the spores germinating during their contact with peptone even in the presence of small quantities of formaldehyde and becoming more susceptible after the time intervals corresponding to the flat portions of the curves.

Further work is under progress and the details will be published elsewhere.

Department of Pharmacy, V. SUBBA RAO.
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REVIEWS

DOVER BOOKS

Linear Groups with an Exposition of the Galois Field Theory. By Leonard Eugene Dickson. Pp. xvi + 312. Price \$ 1.95.

The author of this book is well known for his contributions to the Theory of Groups as well as to the Theory of Numbers and the re-edition of this book, for long out of print, will therefore be welcomed by mathematicians.

The Dover edition for this book has incorporated an Introduction by Professor William Magnus, who surveys the development in the subject since the book was first written and gives his own assessment of its significance for the present-day student. *Linear Groups* is divided into two parts. The first part contains an extensive presentation of the Theory of Galois Fields, and includes a large number of examples. The second part of the book is a comprehensive treatment of linear groups in a Galois field and contains a survey of the known simple groups of finite composite order.

K. S. V.

Introduction to Symbolic Logic and Its Applications. By Rudolf Carnap. Pp. xiv + 241. Price \$ 1.85.

This book gives a clear and rigorous introduction to modern symbolic logic. The author develops the subject from elementary concepts and simple exercises through the construction and analysis of a number of relatively complex logical languages. The second part of the book is a detailed treatment of the applications of symbolic logic to the clarification and axiomatization of various theories in mathematics, physics and biology. Different topics, such as, the sentential constants, predicates, truth-tables, universal and existential sentences, cardinal numbers, finite and infinite concepts, axiom systems for the set theory, arithmetic, geometry, space-time topology and biological concepts, are treated in detail. The logic of relations is given a particularly extensive treatment.

There are very few readable books on symbolic logic and the present one will therefore satisfy the needs of all who wish to get acquainted with this abstract subject.

K. S. V.

Cambridge Tracts in Mathematics and Physics : Integral Equations. By F. Smithies. (Cambridge University Press), 1958. Pp. x + 172. Price 27 sh. 6 d. net.

The book under review has been brought out as a successor to Maxime Bocher's tract *An Introduction to the Study of Integral Equations* which has long been out of print. It is devoted entirely to non-singular linear integral equations, that is, those for which the main results of the Fredholm theory are valid.

The Lebesgue integral is used throughout. Most of the theory is given for the case of L^2 kernels, which illustrate all the phenomena likely to be encountered in practice. Apart from the introductory chapter which gives the connexion of integral equations with differential equations and a few mathematical preliminaries, the book contains seven chapters, each consisting of several existence or convergence theorems. *Chapter Headings*: Introduction, The Resolvent kernel and the Neumann series, The Fredholm theorems, Orthonormal systems of functions, The classical Fredholm theory, The Fredholm formulæ for L^2 kernels, Hermitian kernels, Singular functions and singular values.

While the flavour of the book is essentially pure mathematical, it will prove to be valuable to the wider circle of applied scientists as well. The tract is bound in paper cover, but the quality of printing leaves nothing to be desired.

K. S. V.

Crystal Structures. Supplement IV. By R. W. G. Wyckoff. (Interscience Publishers, Inc., New York.)

Reviews on this monumental work have appeared in the columns of *Current Science*. In order to bring the work up-to-date, supplements are issued from time to time and the material under review styled as Supplement IV completes Chapters IX, X, XIII-XV. The sheets consisting of text, tables, illustration and bibliography are in the nature of either replacement or supplement pages. The bulk of the material deals with organic compounds. In the pages devoted to inorganic compounds, Hydrates and Ammoniates fill the bulk. The bibliography is brought up to 1955.

Supplement IV should be acquired by all those who have already got the other volumes of *Wyckoff Crystal Structures*.

A. J.

Visual Problems of Colour, Vols. I and II. (Symposium No. 8 of the National Physical Laboratory, U.K. Her Majesty's Stationery Office, London), 1958. Pp. viii + 750. Price per set of two volumes £ 2. 2 sh.

The perception of colour and the physico-chemical processes responsible for it has been in recent years a field of considerable fruitful activity by physicists, biochemists, and physiologists. The above two volumes contain the Proceedings of a symposium on the "Visual Problems of Colour" held at the National Physical Laboratory, from 23rd to 25th September 1957. The symposium opened with the Selig Hecht Commemorative Lecture by Prof. George Wald (Harvard) on the "Retinal Chemistry and the Physiology of Vision". Besides the above lecture, the two volumes reproduce the forty contributed papers and the discussions thereof that took place during the symposium. The papers are grouped under the heads of (i) Visual pigments particularly in relation to colour vision, (ii) Brightness matching and colour matching, (iii) Subjective colour measurement, (iv) Electro-physiological aspects of vision, particularly colour vision and (v) Colour theories.

The two volumes are replete with diagrams, graphs and references to literature and the publishers have indeed got up a fine record of the symposium which would no doubt prove useful to all those engaged in the study of the problem of appreciation of colour by the human eye.

D. K.

An Introduction to Electronics for Physiological Workers, Second Edition. By I. C. Whitefield, D.Sc. (MacMillan & Co., Ltd., London), 1959. Pp. xi + 263. Price 18 sh.

Here is a good introductory text on electronics specially suited for those who frequently use electronic devices and techniques but do not have the necessary background of electronics. It "aims to provide an introduction to the subject for those graduate students and others who wish to use electrophysiological techniques, and who should be prepared to do so with some understanding". Although the analogies taken from common biological phe-

nomena and processes will specially appeal to physiological workers, the material chosen and the presentation are such that the book should be quite useful to workers in other fields as well.

Within the limited space of about 250 pages are treated the fundamentals of the operation of electron devices—the vacuum and gas-filled tubes, the photoelectric cells, the cathode-ray tube, and also the basic functions performed by them. Separate chapters deal with each of the important topics like feedback, the cathode follower, noise, interference and screening, filters and attenuators, trigger circuits and time bases. The last two chapters incorporate a brief account of the more recent advancements, viz., the physics and circuitry of transistors. The good get-up and the large number of neatly drawn and self-explanatory figures and curves are among the attractive features of the book. Select references to standard advanced texts are appended to each chapter.

The book may not be very helpful in designing and building electronic apparatus to given specifications. It is, however, easily readable and covers, mostly in a qualitative manner, all the basic principles and other relevant information to give a good understanding of the subject.

A couple of additional chapters describing the operation of typical complete units like a cathode-ray oscillograph, stimulators, a telemetering unit, a recorder, a counter, etc., would have made the book more useful for physiological workers.

V. N. CHIPLUNKAR.

M. SIRSI.

Principles of Alternating Currents. By W. Sluckin and J. R. Greener. (Cleaver Hume Press, London W. 8), 1959. Pp. 338. Price 15 sh.

Technicians and practising engineers who are already familiar with the popular books in the Cleaver-Hume Electrical Series, edited by Professor Cotton, will welcome this second edition of the book *Principles of Alternating Currents* by Sluckin and Greener. This edition has been revised in the light of the general adoption of the M.K.S. system of units and in keeping with the modern trends in electrical engineering. The fundamentals of electronics have been included with special reference to semi-conductor devices for rectification.

Assuming no more than the essential elementary knowledge of Electricity and Magnetism

on the part of the user, the book has been written as a self-contained text which can be read and understood easily. Students and technicians taking the preliminary examination in electrical engineering will find the book very useful.

A. S. G.

Recent Progress in Hormone Research, Vol. XIV. Gregory Pincus—Editor. (Academic Press, New York), 1958. Pp. vi + 582. Price \$ 13.50.

We welcome the publication of the Proceedings of the Laurentian Hormone Conference 1957, portraying authoritative articles and discussions on varied endocrinological topics. The subjects traversed comprise cancer, ageing, sexual abnormalities, steroid chemistry, anxiety neuroses, etc. The first essay is on 16-Hydroxylated steroid and its biological activities. A number of steroids are known to exhibit hormonal activity. A chapter on the effects of cattle-raising and poultry makes interesting reading. It is known that certain hormones have profound influence on rate of growth, fattening, milk secretion, etc. Treatment of poultry with estrogen has been exploited to produce millions of meat chicken, more than 150 millions being treated per year.

Mammogens and lactogens have been engaging our attention from a long time and particularly there appear to be a number of mammogens and lactogens. The chapter on mammary growth and lactation by hormones includes discussions on the above aspects. Five important pituitary hormones play major role in mammatogenesis and lactogenesis; thyroid-stimulating hormone appears to be not connected with the above.

The presence of sex-chromatin as a distinct stainable body in the nucleus has been an excellent tool in the hands of cytologists in distinguishing the female sex. Majority of rodentia so far examined do not show this dimorphism, probably due to difficulty in technique, while a number of other mammals (a marsupial, ungulata, carnivores, primates) disclose the sex-chromatin. In addition, an account of sexual pathology is also included.

Lipids are present in the blood serum as lipoproteins and these are present in increased proportion in certain patients. It is well known that lipid concentrations in serum are to a certain extent under hormonal control. Besides, in the ground substance of the connective tissue, acid mucopolysaccharides are constantly

present and these are also influenced by the hormones. Cortisone and hydrocortisone are found to inhibit the metabolism of mucopolysaccharides. It is also pointed out that growth hormone may be involved in the formation of another type of mucopolysaccharide.

In discussing the excretion of epinephrine and norepinephrine, reference is made to individual variations taking instances from hockey players and to how Goodall tested the adrenal of a lion by specially going over to Africa and found high amounts of norepinephrine.

We are sorry to note quite a few printer's devils but this does not detract the usefulness of the volume for advanced students in Endocrinology, in keeping with the volumes that have already been published. The volume is adequately indexed.

L. S. R.

Analytical Applications of Diamino-Ethane-Tetra-Acetic Acid. By T. S. West and A. S. Sykes. (Published by the British Drug Houses Ltd., England), 1959. Pp. 106.

A new branch of analytical chemistry—Complexometry—was created about fifteen years ago as a result of the pioneering researches of Schwarzenbach, on the formation of complexes between metallic cations and a group of aminopoly carboxylic acids called 'complexones'. Owing to the presence of both ligand forming nitrogen atoms and carboxyl oxygen of the acetate group, ethylene-diamine-tetra-acetic acid is one such versatile complexones. This chemical (or its disodium salt) has found extensive applications in a variety of analytical and industrial problems. The booklet under review gives a comprehensive account of this under 10 chapter headings. The physico-chemical principles involved in this technique and the choice of metal ion indicators used in E.D.T.A. titrations are described in earlier chapters. The use of E.D.T.A. in the analytical estimation of over 40 metals has been indicated with adequate experimental details in the procedure. Several anions like arsenate, bromide, chloride, chromate, ferrocyanide, phosphate, etc., may also be determined by E.D.T.A. method. A particular application of E.D.T.A. which has received wide attraction is its use in the determination of hardness of water. Analysis of several technical materials can also be made with E.D.T.A. and its ability to mask several interfering metals has attracted wider attention. Such an exhaustive account of the analytical application of E.D.T.A. has been described in

the short space of about 90 pages with 468 references to the original contributions by the two authors who are well known analytical chemists. The printing error in the Nernst equation on p. 18 will have to be rectified in the next edition.

It goes to the credit of B.D.H. who have been bringing out such handy publications from time to time for ready reference.

M. R. A.

Third Tissue Homotransplantation Conference.
(*Annals of the New York Academy of Science*, New York, Vol. 73, Art. 3), 1958. Pp. 539-868.

The discipline of tissue transplantation has been the venue of much experimental work but it is only in recent years that any advances have been made. Having in mind that the ultimate goal of this discipline is the elimination of the cause of human suffering and death, its importance cannot be overstressed. However, the difficulty involved is apparent when one sees that the only examples of permanent transplant survivals in man, to date, are skin and kidneys in identical twins, and occasional successes in functioning endocrine homografts.

The hopeful advances, referred to above, are mainly with reference to invertebrates and, in some specialised circumstances, to vertebrate homotransplantation. Degree of immaturity and alterations in the immune mechanisms of the host seem to be factors responsible for successful homotransplantation in vertebrates. And it is these successes which have led clinicians to hope that "spare parts" may one day be used in human medicine.

In presenting this series of papers, at the "Third Tissue Homotransplantation Conference", the editors have provided a picture of the present-day status of this subject. It is dealt with under various heads.

A short introduction by John Converse and Blair Rogers does not claim to act as a review of the papers that follow.

Part I is devoted to Embryonal, Foetal, Neonatal and Infant Tissue Transplantation. In this connection Helene Toolan has shown that in Cortisone-treated rabbits there is a prolonged survival of adult and embryo homografts. Synderman's duplication of Toolan's embryo graft experiments in humans have indicated interesting possibilities of graft survivals. Besides these two papers, there are five others on related topics.

Eight papers of Immunogenetics of Tissue Transplantation constitute Part II. It seems, from the work done by Berrian and Brent, that the destruction of transplants is due to the process of active immunization entailing the formation of antibody-like reaction sites either on the surface of cells of regional lymphoid tissue or within them.

Part III, on Antibodies and Antigens in Tissue Transplantation, contains eleven papers and some problems of the most absorbing interest, such as those dealing with specific desensitization of the delayed hypertensive state and passive transfer of serum antibody against skin homografts.

The last eleven papers in Part IV involve Graft versus Host Reaction in Acquired Tolerance in Tissue Homotransplantation. Ten questions, concerned with tissue transplantation, have proved as captivating to the minds of investigators as those on acquired tolerance.

The monograph is highly recommendable to students of Homotransplantation.

B. R. S.

Books Received

The Value of Science. By Henri Poincaré. (Dover Publications, New York 10, N.Y.), Pp. 147. Price \$1.35.

Conceptual and Methodological Problems in Psychoanalysis. By L. Bellak. (*Annals of the New York Academy of Sciences*, New York 21, Vol. 76, Art. 4). Pp. 971-1134. Price \$2.75.

Chemical Analysis—Vol. 3, Colorimetric Determination of Traces of Metals, III Edition. Revised and Enlarged. By E. B. Sandell. (Interscience Publishers, New York 1), 1959. Pp. xxii + 1032. Price \$24.00.

Technical Note No. 22—World Meteorological Organisation Preparing Climatic Data for the User; No. 24—Turbulent Diffusion in the Atmosphere. By H. E. Landsberg. (WHO Avenue de La Paix, Campagne Rigo, Geneva). Pp. 18; 68. Sw. Fr. 4 and 7.

Endocrine Control in Crustaceans. By D. B. Carlisle and F. Knowles. (Cambridge University Press, Bently House, London, N.W. 1). *Science, Philosophy and Religion*. By Russell Brain. (Cambridge University Press, London, N.W. 1). Pp. iii + 30. Price 4 sh. 6 d.

The Coconut Palm—a Monograph. By K. P. V. Menon and K. M. Pandalai. (Indian Central Coconut Committee, Ernakulam, S. India). Pp. xvi + 384. Price Rs. 38.00.

SCIENCE NOTES AND NEWS

Award of Research Degree

The thesis of Shri K. S. Kushwaha (of the Rajasthan College of Agriculture, Udaipur) on the morphology and chætotaxy of Indian termites, has been accepted for the Ph.D. Degree of the Rajasthan University. Shri Kushwaha worked under Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta.

Andhra University has awarded the D.Sc. Degree in Technology to Sri. C. Chiranjeevi for his thesis entitled "Study of Local Boiling at Low Heat Fluxes".

Lithium Radiation in Twilight Sky

Many reports of observation of the resonance line 6707.8 Å of lithium in the spectrum of the twilight sky, have appeared recently. The radiation is reported to have been observed at Terre Adelie (Antarctica) in 1957 and 1958 (C. R. Acad. Sci. Paris, 246, 2925, 1958). It was prominently observed at Hallet Station (Antarctica) in August, 1958, and at Invercargill (New Zealand) in September, 1958, (*Nature*, 182, 1598, 1958). Reports of its observation have also come from stations in the northern hemisphere, from Saskatchewan, Canada, (*Nature*, 183, 1315, 1959) and from Aas, Norway (*Nature*, 183, 1385, 1959).

Various theories have been proposed for the origin of atmospheric lithium producing this radiation (*Nature*, 183, 1480, 1959). These theories are based on the estimated ratio of the intensities of the lithium line and the D lines of sodium in the observed spectrum and calculating therefrom the ratio of abundance of the two metals in the upper atmosphere of the earth. This abundance ratio is then compared with that expected if the common origin of these elements in the earth's atmosphere is (i) in sea-water or (ii) in meteoric vapours. The lithium sodium ratio according to marine origin should be 2.3×10^{-5} , whereas the ratio for their meteoric origin should be 200×10^{-5} . The computed value of the Li/Na concentration ratio, based on the present line intensity estimates, does not enable one to fix the origin unambiguously. Further evidence is necessary for this.

It is to be noted, however, that the almost equal intensity of the lithium and sodium lines

observed at Hallet station in the middle of August, 1958, may be partly due to the Johnson Island nuclear explosion that took place earlier, on August 1. Equal intensities of the lithium and sodium lines would result from a lithium concentration 5% that of sodium.

We may conclude that probably more than one source are responsible for the lithium content of the atmosphere. Marine origin, meteoric debris and disintegration of atmospheric atoms by cosmic radiation are the permanent sources. Volcanic eruptions and nuclear bomb explosions may occasionally increase the concentration.

A High Frequency Valve

The "Tecnatron", first demonstrated to the public at the recent Milan Fair, is a French invention based on the properties of semi-conductors. The American scientist Lilienthal discovered in 1928 that if an electric current is made to flow through a thin layer of semi-conductor (Lilienthal used copper sulphide) the current can be varied by an electric field set up perpendicularly to the plane of the layer. Various studies of this field were made in America and France, and the French workers at the Centre National d'Etudes des Telecommunications calculated that certain advantages would follow if the field were exerted uniformly over the perimeter of a cylinder of semi-conductor material. This was the basis of the experiments which led to the Tecnatron.

Starting with a plate of single-crystal germanium containing a small amount of other substances (*n*-type), a large number of minute rods, 2 millimetres long and 0.5 millimetres diameter, are cut by an ultrasonic method perfected by the CNET. Electrodes are welded to the ends of each rod, which is then subjected to an accurately controlled process of electrical "formation" in specially developed equipment. After etching with a fine jet of acid, an annular groove is cut into the rod, in which a ring of metallic indium is deposited by another jet. The technique used ensures a remarkable degree of purity in the germanium-indium contact and at the surface of the germanium. At the end of the jet treatment the assembly, which looks like a tiny pulley, is mounted on a pinch and sealed into a metal cap which is filled with helium.

The completed device has a unique property. Not only will it amplify small voltages applied to the appropriate terminals, but its ability to do so tends to increase as the frequency of the applied signal increases. This gives it a decisive advantage over thermionic valves and transistors, whose performance falls off with increasing frequency. Moreover, the Tecnetron, in common with other semi-conductor devices, operates with negligible expenditure of energy. The limit of the useful frequency range is determined only by the method of construction and a frequency of 500 megacycles/second (about the highest used in short-wave radio) is readily attained.—*Science Newsletter*.

New Use for Old X-Ray Tubes

In a communication to *Acta Crystallographica* [1959, 12 (5), p. 417] Lonsdale and Milledge write that they have found a new use for a heavily contaminated sealed-off X-ray tube which was giving, in addition to CuK_α and β , considerable amounts of NiK and WL radiations.

In the course of examining random-rotation photographs of synthetic diamonds, taken with a clean tube, the presence of a satellite face-centred cubic structure was observed. The lattice constant of this is 3.539 \AA which is slightly less than that of diamond, which is 3.567 \AA . This structure gives reflections very close to the positions where the diamond 200 and 420 would have been if not 'forbidden', and its other reflections are all just on the larger-angle side of observed diamond spots. The satellite and diamond structures are clearly parallel in orientation.

By taking rotation and Weissenberg photographs with the contaminated X-ray tube, and then studying relative intensities of the NiK_α , CuK_α and CuK_β reflections for diamond and for the satellite spots respectively it was possible (i) to prove that satellite was rich in nickel, since it differentially absorbed the CuK_β radiation, and (ii) to estimate the approximate amount of nickel present, and the size of the grains in which it was concentrated.

The use of an X-ray tube giving many different radiations simultaneously ought, in principle, to provide the means, by a study of differential absorption, both of determining the kinds of inclusion atoms present in a known matrix, and their relative amounts, even when no absorption edge is available and when the structure of the inclusions is unknown.—*Acta Crystallographica*, May 10, 1959.

Sound Waves of 10,000 Megacycles

Ultrasonic waves of extremely high frequencies, of the order of 10,000 megacycles, have been produced by a method which combines microwave techniques with those of conventional ultrasonics. In this method, discovered by Dr. Jacobsen of the General Electric, microwave pulses are applied to a quartz crystal maintained at as low a temperature as 2°K . in a specially designed cavity-resonator. The low temperatures assist in keeping the ultrasonic vibrations from "degenerating" into vibrations associated with the heat content of the material. This unusual type of "heat barrier" is one of the biggest problems in achieving higher and higher frequencies.

Sound waves of all frequencies can be transmitted into solids. Many metals and other solids reflect electromagnetic microwave radiation and resist penetration by waves in certain parts of the electromagnetic spectrum. Thus, the new ultrasonics will help fill the gap and provide an important tool in solid state research—*J. Frank. Inst.*, April 1959.

Melting Point of Iron at 96,000 Atmospheres

H. M. Strong of the General Electric Research Laboratory, N.Y., reports in *Nature*, May 16, 1959, that the fusion curve of iron has been experimentally traced to 96,000 atmospheres. The curve follows a smooth course over the entire pressure-range from 1 to 96,000 atmospheres with no indication of the existence of a triple point. The apparatus used was the same as that used for the synthesis of diamond. At a pressure of 96,000 atmospheres, the melting point of iron was found to be $1,740 \pm 15^\circ \text{C}$.

The fusion curve extrapolated to 1.4×10^6 atmospheres gives the melting point of iron at this pressure as $2,340 \pm 50^\circ \text{C}$. This helps to fix the temperature of the Earth's core.

Recent theories suggest that the boundary of the Earth's core is molten iron, with the central part of solid iron. The pressure at the boundary between the Earth's mantle and the liquid core is estimated as about 1.4×10^6 atmospheres. The above determination of the melting point of iron would thus set a minimum temperature of the Earth at this depth as about $2,340^\circ \text{C}$.

Giant Linear Accelerator

America is to build an electron linear accelerator two miles long and with an ultimate energy of 45 BeV (45 thousand million electron

volts), making it by far the largest atom smasher of its type in the world. It has been proposed by Stanford University, California, which has also undertaken the design study, and the plan is to build it there. Construction is expected to take about six years. Stanford University has had a smaller electron linear accelerator (700 million electron volts and 220 feet long) in operation since 1952. The Soviet Union has one of one thousand million electron volts and France is building one of the same size.

Atom smashers enable scientists to split atoms apart and to explore the fundamental nature of matter and energy. They include synchrotrons, cyclotrons and electrostatic generators, as well as linear accelerators. Linear accelerators look something like the barrels of big guns. They accelerate particles—electrons or protons—in a straight line through a long tube by a series of small pushes.—*Atoms for Peace Digest.*

Electric Power from Nuclear Energy

The Atomic Energy Commission at the Los Alamos, New Mexico, scientific laboratory has announced the direct conversion of nuclear reactor energy into electric power.

This was the result of an experiment in which ionized caesium gas was substituted for one of the two elements of a thermocouple—the other being enriched uranium.

In this experiment, a rod of enriched uranium, surrounded by caesium gas, was lowered into the core of a reactor. When this was done the neutron flow activated uranium fission in the centre of the thermocouple while the flow of the reactor coolant around the outside of the container lowered the temperature of the caesium gas.

It is expected that the new device would by-pass the intermediate step performed by turbines in the present conversion of nuclear power to electricity.

Oxygen-17

The large distillation columns in the Isotope Research Department of the Weizmann Institute are now being used for the separation of the stable oxygen isotope, oxygen-17. They are already distilling heavy water to obtain oxygen-18: the Weizmann is apparently the world's only supplier of this isotope, which is used primarily in non-radioactive tracer experiments as a means of labelling certain

oxygen atoms in molecules. The position of the oxygen-18 at the end of the experiments is obtained by analysis in a mass spectrometer. This has certain disadvantages: it involves the destruction of the specimen and the conversion of the oxygen-18 into carbon dioxide or water, and the techniques are difficult and rather slow.

Oxygen-17 can be traced much more readily because its nucleus has a magnetic moment and can be detected by radio-frequency resonances. This means that the position of the oxygen-17 atom should be detectable non-destructively, so that the sample can be used for further stages in the experiment. Also, since the exact frequency at which resonance occurs depends on the type of chemical bond holding the oxygen atom into the molecule, it should be possible to distinguish between different kinds of bond.

Oxygen-17 is made by distilling water in such an efficient column that the heavy water component containing oxygen-17 can be partially separated from that containing oxygen-18. A further stage of concentration is then carried out in a film diffusion apparatus. The natural abundance of oxygen-17 is only 0.037%. At the moment the laboratory is producing 3% concentration, but it is hoped eventually to reach 10%.

Plants and Fall-out

Certain observations on plants in the area of the Marshall Islands affected by fall-out from the 1954 Bikini hydrogen bomb test have been reported by F. R. Fosberg in *Nature*, May 23, 1959. Four coral islet stations were examined which had been affected by different intensities of fall-out. Investigations showed abnormal or pathological conditions in certain plant species, increasing from islet to islet in the same order as the increase in fall-out intensity.

On Gegen Islet, the station with the greatest fall-out exposure, of a total flora of 15 species, 13 showed conspicuous pathological or abnormal symptoms, ranging from plants dead to chlorosis, dead terminal twigs and mistletoe-like abnormal growths. On Kabelle Islet, next most heavily exposed, 3 species showed some damage. On Eniwetak Islet, though only 2 species were involved, the symptoms, defoliation and die-back twigs, were so conspicuous as to alter the appearance of the vegetation, causing a general grey colour in place of the normal green. On Likiep Islet which had scarcely any measurable fall-out, no abnormal appearances of any sort were noticed.

The plants most widely affected were: *Suriana maritima* L., *Cordia subcordata* Lam., and *Pisonia grandis* R. Br. In all, 43 species are known from the three atolls heavily affected by fall-out. Only about half these plants grow on the four islets where the heaviest fall-out was recorded. Of these, 16 species were noted to show some abnormality. Two species of universal occurrence and great abundance, *Scævola sericea* Vahl and *Tournefortia argentea* L. f., showed no abnormal appearance whatever.

Then and Now

"Fifty years ago it was the common practice in science for a man to put a trade-mark, so to speak, on a certain aspect of science which he himself had started to investigate. If he would publish a paper, it was notice to his scientific colleagues that this was his little private province and that other people should keep off the ground and let him develop it and see what he could do.

"This is a point of view which has almost completely disappeared within the last generation. And it has disappeared because it has been found that the speed of advance has been much greater when a number of people approach the same problem from different points of view and compare ideas so that each can contribute, can fill in gaps in the other person's information, and thus the information grows more rapidly.

"This has been found mutually so advantageous that it has become the modern pattern of science, and the openness of information in science is a part of this same process that has been going on with the development of patents in industry and so on."—*Arthur H. Compton.*

Polar Lights on Venus Confirmed

The observations of luminous glow in the atmosphere of Venus, first made by the Soviet astronomer Dr. Nikolai Kozyrev, have been confirmed by the American scientist, Gordon Newkirk of Colorado Observatory. The first spectrum photograph of this glow was made by Kozyrev in 1953 by means of the 50 in. telescope he used in observing the recent volcanic eruption on the Moon.

"When we observe the crescent Moon", says Kozyrev, "we can also faintly see the rest

of the moon's disc. This is due to the darker portion being illuminated by sunlight reflected from the Earth. Venus goes through phases similar to those of the Moon. When the planet is observed as a crescent, we can see light from the darker portion of Venus. As Venus has no satellite, this light cannot be due to reflection. By making spectral studies, I found out that the light should be attributed to a glow of the outer atmosphere of Venus, very similar to the shine of the night skies of the Earth. An analysis of the photograph shows no traces of oxygen in the spectrum. Instead, the glow of molecules of nitrogen has been registered, a phenomenon observed in the polar lights of the Earth. It seems that polar lights were at play on Venus when I took the photograph."

The Guenter Loeser Memorial Lecture for 1959

Dr. Norman A. Haskell of the Geophysics Research Directorate, who has distinguished himself in various areas of geophysical research for more than 20 years, delivered the Guenter Loeser Memorial Lecture on "The Detection of Nuclear Explosions by Seismic Means" on May 26, 1959, in the New England Mutual Hall, Boston, Mass.

The Guenter Loeser Memorial Lecture is a tribute to a distinguished scientist who was killed in 1953 while engaged in a meteorological research aircraft flight. In 1954 Dr. Loeser's friends and colleagues conceived of this lecture as a lasting memorial. The honour to deliver the lecture has been awarded previously to Dr. Jean I. F. King in 1955, Dr. Robert G. Breene, Jr. in 1956, Dr. David Atlas in 1957, and Mrs. Rita C. Sagalyn in 1958.

Grant for Fieldwork

The Bombay Natural History Society, 91, Walkeshwar Road, Bombay 6, will offer financial assistance for specific pieces of fieldwork in Natural History carried out during the current year, and shall be glad to hear from members and others interested.

Please apply to the Honorary Secretary giving full particulars about the nature of work proposed to be carried out, total cost of project and amount required and previous experience.

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1. INTRODUCTION

IN describing and interpreting our visual impressions, it is natural to adopt the geometric approach provided by ray-optics, since this is the most familiar and therefore the most easily understood approach. But this does not mean and it would indeed be incorrect to assume that even the most familiar optical effects which we can perceive with the unaided vision can always be explained on the basis of the ideas of geometrical optics. The propagation of light in various circumstances needs in general the concepts of the wave-theory for its correct and complete elucidation. Only in the particular case of a set of waves of constant type and the rays associated with them are the wave-optical and ray-optical descriptions completely equivalent.

The foregoing remarks have a bearing on the phenomena of atmospheric optics, in other words of the effects noticed when distant sources of light are viewed through great depths of air. The atmosphere of the earth is an inhomogeneous medium and though the refractivity and its variations are both small, this is set off by the very long optical paths often involved. Hence, the deformations of the wave-fronts in their passage from the light-source to the observer are by no means negligible and in particular circumstances, their consequences may be very conspicuous. The familiar phenomenon of the twinkling of the stars may be cited as an example. In the case of terrestrial objects, we are concerned with the lower levels of the atmosphere where the refractivity is a maximum and also liable to large variations by reason of a variety of circumstances. Hence, a variety of effects may arise which are readily observable. As remarked above, it would not be correct to assume that these effects can all be understood or explained on the basis of the ideas of geometrical optics. It is, on the other hand, to be anticipated that the aid of the wave-theory would be needed for the purpose.

2. THE ORIGIN OF MIRAGES

Mirages constitute a remarkable group of effects arising from variations of the refractive index of the atmosphere. They are generally described as of two kinds, being respectively the so-called superior and inferior types of mirage. The latter are quite common and may be described as the manifestation above the

level heated surface of the earth of a reflection of the sky and other elevated objects: the latter appear as inverted images against the background of the reflected sky and thus simulate the reflection of terrestrial objects at the surface of a pool or lake. The superior type of mirage arises when the thermal conditions of the atmosphere are the reverse of those which give rise to mirages of the inferior type; they are observed when the atmosphere rests on a cold level surface above which there lies a hot stratum of air. Objects at or near the level of the cold surface are usually visible to the observer, and in addition inverted images of them are also seen higher up in the atmosphere. Pictures of both types of mirage are to be found reproduced in many treatises on optics and meteorology. A famous example of the superior type of mirage in which objects thus seen reflected were ships at sea was that described and figured by Vince in the year 1799. His drawings are reproduced or referred to in many accounts of the subject. We shall have occasion to refer to them again later in this article.

3. MIRAGES AND RAY-OPTICS

The theory of mirages usually accepted purports to base itself on geometrical optics. This explanation is said to have been first put forward by Monge, but it was later elaborated and discussed by many other authors. The interested reader will find a very full review of the literature covering 80 pages in the Second Edition (1922) of Pernier's treatise on meteorological optics as revised by Exner. The explanations usually given are illustrated by drawings which show the curved path of the rays from the source which reach the observer and are perceived by him as a reflected image of the source. These drawings seem very plausible, but when one examines them with care, it becomes evident that the explanations put forward do not really come to grips with the problem and may indeed be described as a kind of make-believe. That a geometric theory is fundamentally incapable of explaining the phenomenon of the mirage becomes clear on a critical examination of the subject.

The circumstances in which mirages are observed bear a superficial resemblance to those in which the familiar phenomenon of total reflection occurs, *viz.*, light travelling in

a medium of higher refractive index meets a medium of lower index at an incidence exceeding the critical angle and is then turned back. There is, however, a fundamental difference between the problem of the mirage and the circumstances of total reflection referred to above. We do not have in the atmosphere anything in the nature of a discontinuous change of refractive index; what we are actually concerned with is a progressive change of index. In the latter circumstances, a pencil of rays travelling obliquely through the stratified medium would, according to Snell's law of refraction, be progressively deviated until it reaches a layer at which its course becomes tangential to the plane of the stratifications; thereafter, it would continue on a course parallel to the stratifications. No question of total reflection can therefore arise.

4. MIRAGES AND WAVE-OPTICS

If it be assumed that the wave-optical and ray-optical descriptions of the behaviour of light are completely equivalent, it would follow that the rays and wave-fronts in an isotropic but inhomogeneous medium are everywhere normal to each other. Accordingly, if the course of the rays is known, the wave-fronts form a set of surfaces cutting them orthogonally. It was stated above as a consequence of Snell's law of refraction that a ray of light initially making an angle with the plane of the stratifications would be progressively deviated from its course until it becomes tangential to that plane and would then continue on a course parallel to the stratifications. This would happen to every one of the rays of an incident beam of light. Accordingly, if we take two adjacent rays at a finite distance apart, the part of the wave-front between them would swing round and at the same time contract in its extension and ultimately become a point which moves parallel to the stratifications in a plane whose position can be specified exactly for the particular circumstances of the case.

An approach to the problem of the mirage based on the ideas of geometrical optics thus leads us to conclude that the energy of the incident radiation would be concentrated at a limiting plane which it reaches but is unable to penetrate. The intensity of illumination in that plane would therefore be infinite. Since such a result is physically inadmissible, it follows that the approach which leads to it should be given up in favour of a different and more rigorous treatment based on the first principles of the wave-theory.

5. THE ANALYTICAL THEORY AND ITS RESULTS

To make the problem tractable, it has to be idealised to some extent. We consider the optical behaviour of a slab of the medium which is assumed to be of finite thickness and bounded by plane parallel faces extending to infinity. The material is also assumed to be stratified in planes parallel to its faces, the refractive index being μ_1 at the front surface and μ_2 at the rear, μ_1 being greater than μ_2 . Plane waves of light are assumed to be incident on the slab at a glancing angle ϕ_1 . It is clear that if $\mu_1 \cos \phi_1$ is greater than μ_2 , the incident waves cannot emerge from the rear face of the slab. We are interested in ascertaining the nature of the disturbance both within the slab and in front of it in the circumstances stated.

The solution of the problem is contained in a paper by S. Pancharatnam and the present author published in the *Proceedings of the Indian Academy of Sciences* for May 1959. We must be content here with a brief statement of the results. The paper quoted also contains a full account of the results of experimental studies on the subject. This will be drawn upon very freely in the latter half of the present article. It should be mentioned that the experiments, besides confirming the results of the analysis have also revealed other unsuspected features which assist in the elucidation of the phenomena actually noticed in mirages on a large scale in the open-air. The illustrations accompanying the present article, Figs. 1, 2 and 3 are also taken from the paper under reference.

Briefly stated, the analysis indicates that when $\mu_1 \cos \phi_1$ is greater than μ_2 , the light incident on the front face of the slab is returned from its interior with full intensity and in a direction justifying its description as a regularly reflected disturbance. The analysis also shows that within the slab, the intensity of illumination attains a large value in the vicinity of the limiting plane at which the refractive index μ_1 has the value $\mu_1 \cos \phi_1$. The intensity falls off rapidly to small values in the rear of that plane, while in front of it, the intensity diminishes gradually at the same time exhibiting a series of maxima and minima of which the separation falls off progressively, finally approaching a constant value.

The situation described above closely resembles the effects well known to all students of optics which are observed in the vicinity of *caustics*. Accordingly, we may in the present case state that the incident and reflected

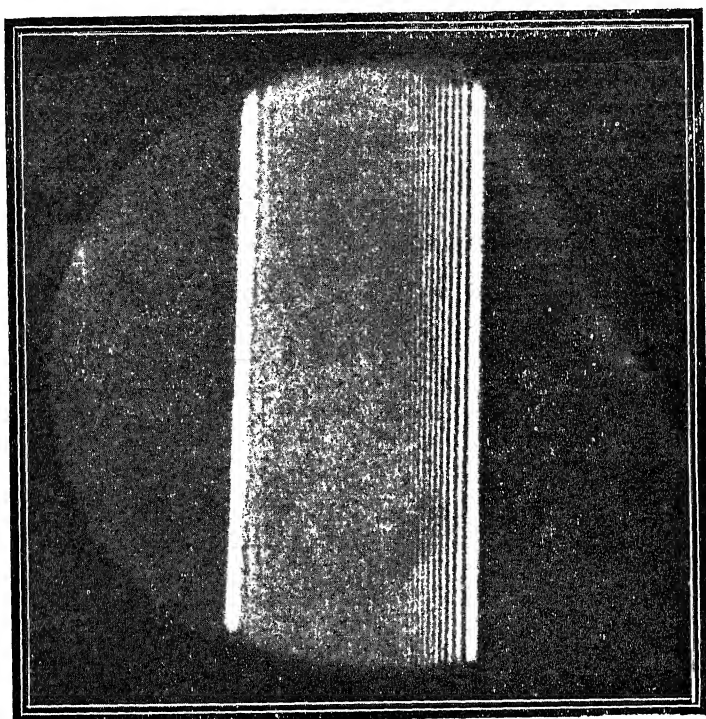


FIG. 1

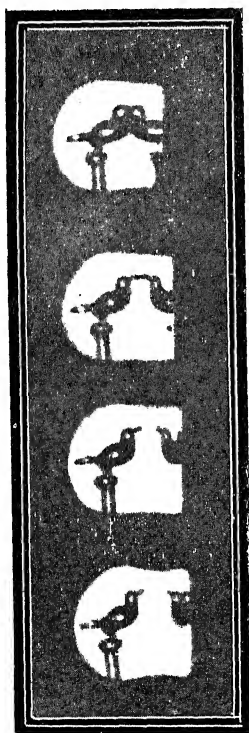


FIG. 2

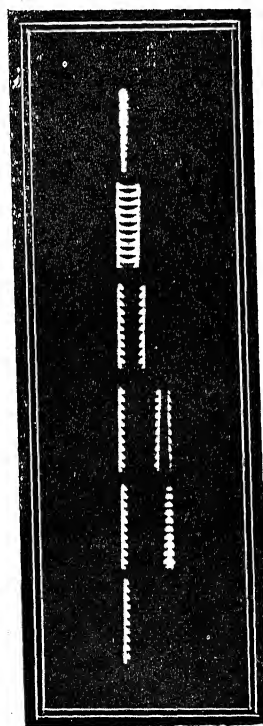


FIG. 3

disturbances join up and form a cusped wave-front; the cusp rests upon the limiting plane referred to above and the entire wave-front moves along that plane in a direction parallel to the plane of incidence. At and near the cusp, the two branches of the wave-front are sensibly parallel to each other, besides being normal to the plane of the stratifications. Further out, however, they separate and diverge, ultimately becoming normal to the incident and reflected rays in the sense of geometric optics. The progressive diminution in the spacing of the successive maxima of illumination is readily understood on this basis.

6. OBSERVATION OF THE CAUSTIC AND ACCOMPANYING INTERFERENCES

Mirages can be produced and observed on a small scale in the laboratory as has been shown by R. W. Wood and others. In the arrangements generally used, the hot plate above which the mirages are observed is held horizontally. Though in some respects this arrangement is very convenient, it is not useful for critical studies owing to the thermal instability of the air above a heated plate. This difficulty is minimised by holding the heated plate edgewise so that its surface is vertical while the length remains horizontal. The object studied is an illuminated slit kept at some distance from the heated plate parallel to its surface. The light diverging from the slit is rendered parallel by a collimating lens and then allowed to fall obliquely on the heated plate. The beam is allowed to cover the whole length of the plate, the angle of incidence being adjustable by a lateral movement of the illuminated slit.

Photographs of the field of illumination in the rear of the hot plate could be secured with these arrangements and with very short exposures, provided that sunlight is used to illuminate the slit. With such short exposures the effects of thermal instability are eliminated completely. A typical example of a photograph thus obtained is reproduced in Fig. 1 accompanying. The use of a red filter to monochromatise the light greatly improves the results obtained. It will be seen that the features indicated by the theory and other features as well are very clearly exhibited.

The field of illumination appearing in Fig. 1 consists of three parts. To the right of the bright caustic (*i.e.*, towards the heated surface) the field is dark, while to its left lies an illuminated strip containing a large number of interference fringes whose separation narrows down to a constant value as we move away from the

caustic; since the heated plate is necessarily of finite extension, the reflected part of the cusped wave-front does not extend to infinity but is terminated. This manifests itself in the field of view by the occurrence of a second edge to the left of which the intensity is considerably less (though not zero), the edge being bordered by some broad fringes.

7. RELATION OF THE MIRAGE TO THE CUSPED WAVE-FRONT

The actual mirage is observed when the eye is kept at any point which lies on the bright strip of light lying to the left of the caustic, the eye being focussed on the plane containing the object, *i.e.*, at infinity. It is to be expected that two images would then be seen whose positions lie respectively along the directions of the normals drawn from the eye to the two branches of the cusped wave-front leaving the nearer edge of the plate. In fact, the fringes observed to the left of the caustic in Fig. 1 may be regarded as due to the interference between the light from two such virtual sources, the progressive narrowing of the spacing of the fringes to the left of the caustic corresponding to the increasing separation of the sources. That the separation of the two images observed depends on the position of the eye or aperture through which the phenomenon is viewed is illustrated in Fig. 3. In order to make the nature of the image evident, the serrated edge of a hacksaw blade has been used to form one of the edges of the slit. An aperture was kept before the camera lens and the succession of photographs exhibit the alteration in the phenomena as the aperture is gradually moved to the left. When the aperture is on the bright caustic, a single image is seen, while as it is moved to the left this separates into two images, one of which is a direct (or more properly, a refracted) image, the second being an inverted reflected image, the separation between the two gradually increasing. A remarkable feature of the sequence of phenomena illustrated in Fig. 3 is the occurrence of a third erect image close to the reflected image in the fourth and fifth photographs of the sequence; this image starts developing when the aperture has been moved towards the outer edge of the central illumined strip (where broad fringes start appearing in Fig. 1) and becomes coincident with the reflected image when the aperture is exactly at the edge mentioned. As the aperture is moved further left, only the 'direct' image continues to be visible, as is shown in the last photograph of the sequence; this is to be expected since the reflected part of the cusped

wave-front is no longer received through the aperture.

The third image mentioned above could be cut off by inserting an opaque screen near the farther end of the heated plate and adjusting it so that its edge protrudes a little beyond the surface of the plate. This shows that the image is due to the ordinary refraction of rays directly entering the edge of the heated layer at the farther end of the plate. The main features of the path of such rays may be deduced from the experimental observations described in the previous paragraph. The terminus of the reflected part of the cusped wave-front corresponds to certain limiting rays entering the region at the farther end of the plate. Rays which are able to enter the edge of the heated layer at a closer distance to the plate than these limiting rays proceed a longer distance before emerging from the heated stratum and also suffer a larger deviation. These rays give rise to the erect third image; in fact, the second refracted wave-front, obtained by drawing the surfaces orthogonal to these rays, meets the termination of the refracted part of the wave-front so as to form a second cusp.

Till now we have dealt mainly with the case when the distant object is of negligible angular dimensions. When an object of finite angular dimensions is used, the point on the image which corresponds to any particular point on the object is to be determined as before for each setting of the eye. In this case there will

be a distortion of the images because the position of the limiting layer as well as the inclinations of the cusped wave-fronts corresponding to any particular point on the object varies with the position of the object-point. Figure 2 shows the photographs taken using as the object a small model of a bird made of glass. This was placed near the focal point of the collimating lens. The sequence of photographs show the variation in the appearance of the phenomena as the eye is moved away from the plane of the plate. The appearance of a third erect image in addition to the usual reflected image may be discerned in the last two photographs of the sequence. It is worthy of note that a third erect image adjoining the inverted image which is the principal feature of the mirage has actually been noticed by various observers in mirages as seen in a large scale in the open air. It was noticed, for example, by Hiller in his study of mirages of the inferior type produced by a long vertical wall which had been warmed by the sun's rays. Hiller's photograph showing this effect is reproduced in Pernter's treatise already mentioned and also elsewhere. The third erect image is a conspicuous feature in Vince's drawings of ships at sea exhibiting the phenomenon of the superior mirage. It may safely be presumed that the explanation of its appearance is analogous to that of the effect noticed in the laboratory experiments and illustrated in Figs. 2 and 3 above.

COMMONWEALTH EDUCATION CONFERENCE

THE report of the Commonwealth Education Conference, presented at the final session at Oxford on July 28, 1959, adds an important chapter to the history of Commonwealth endeavour and co-operation.

The Conference has helped to carry a step forward the scholarship scheme originated by Canada and approved last year at Montreal. As a result not only will the scheme come into force in the year 1960-61 but the target of 1,000 scholarships may well be exceeded. Of these United Kingdom has offered to provide 500 and Canada 250. In the main the Commonwealth Scholarships will be for post-graduate study or research. A limited number of awards will be made to senior scholars of established reputation and achievement and called Commonwealth Visiting Fellowships.

The report points out that over the first five years Commonwealth Governments will spend at least £10,000,000 in addition to their present expenditure, on education.

One of the major problems to be solved is about the acute shortage of trained teachers. While the long-term problem of Teacher Training needs must be solved by the respective countries themselves, the report shows that a number of practical suggestions have been made at the Conference to meet the immediate needs.

On the supply of teachers the report estimates that 500 teachers are wanted immediately for training institutions, well over 1,000 a year for secondary schools, and 200 a year for technical schools. Universities also need staff, often in highly specialized subjects. In this respect the attention of Governments is being drawn to the need for satisfactory arrangements for the reception and welfare of the scholars and teachers on which much of the success of the plan will depend.

The report suggests that funds are to be allocated for teaching English as a second language, and a group of Commonwealth experts will shortly consider the problems involved in teaching this subject.

STRUCTURE OF POLIO VIRUS AS REVEALED BY X-RAYS

X-RAY analysis of crystals of poliomyelitis virus by Dr. A. Klug and Mr. J. T. Finch of Birkbeck College, London, has thrown new light on the basic structure of the virus. The virus particle has been shown to have the geometrical symmetry of the figure known as an *icosahedron* (a closed shape with twenty plane faces).

Poliomyelitis virus, which is one of the smallest viruses, is shown by electron microscope to be a spherical particle about $3\text{m}\mu$ in diameter. Chemical studies have shown that small viruses consist of protein molecules and RNA (ribonucleic acid), which in living cells is believed to be responsible for the synthesis of proteins. Scientific interest was focussed on virus structure more than two decades ago when it was found that some of the viruses which cause plant diseases could be prepared in a crystalline form, and as such X-ray techniques could be used for studying their structure.

The first fruitful application of X-ray analysis of virus structure was in the case of the tobacco mosaic virus (TMV). Here X-ray studies revealed that the rod-shaped virus, about $2\text{m}\mu$ in diameter and $30\text{m}\mu$ in length, had a helical structure which arises from the regular arrangement of identical protein units in the form of a screw thread (as yet unknown whether left or right handed) and leaving a narrow axial hole about $0.3\text{m}\mu$ in diameter. Further it was shown that the RNA content of the virus was located some $0.4\text{m}\mu$ from the central axis most probably arranged as a single strand of the long continuous "backbone" of the molecule sandwiched in helical form between the successive turns of the outer protein helix. In the intact molecule it is inferred that this arrangement of the RNA confers some degree of stability to the protein sheath of the virus, presumably because it is bound to the units of the sheath by chemical or other forces.

Poliomyelitis viruses are considerably more difficult to handle and so far the picture of their structure which has been built up is not as nearly complete as that of TMV. From the new investigations of Klug and Finch it has been possible to conclude that the virus is built up of sixty identical units arranged and held together in such a way that they form a shape with the correct icosahedron symmetry (Fig. 1). The icosahedron, which is one of the five regular polyhedra, can be pictured as two regular pentagonal pyramids with their pentagon bases separated parallel to each other and twisted, so that the sides of the one are opposite the

vertices of the other. The ten points of the two pentagons when joined will form ten equilateral triangles alternately upright and inverted, girdling the two pyramids. With the five faces of each of the two pyramids there will thus be twenty triangular plane faces in the icosahedron.

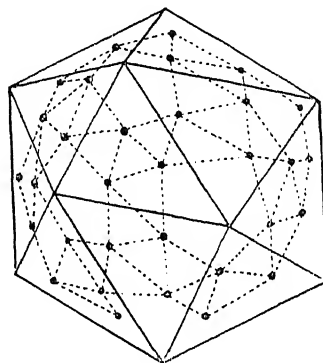


FIG. 1. An icosahedron drawn round a diagram of polio virus. Each dot represents a protein unit and related to the icosahedron in a symmetrical way.

The suggestion has been put forward that the sixty units are protein molecules. These units are arranged to form a roughly spherical shell in which each unit will be surrounded by either four or five immediate neighbours. (The second arrangement is the more probable.)

This is the first time that the detailed internal structure of an animal virus has been elucidated. The poliomyelitis virus has a structure which is similar to several of the small plant viruses (turnip yellow virus and bushy stunt virus for example) which also have been shown by X-ray analysis to consist of spherical shell with icosahedral symmetry. It is now becoming clear that geometry plays an important part in virus structure. The reason for the particular geometry displayed by the spherical viruses is probably that this icosahedral arrangement is the most economical way of "packing" the small protein units round a central core.

In its way this structure of the poliomyelitis virus is similar to that of TMV. There is a sheath of protein surrounding or containing RNA in some position as yet unidentified. The protein, as in TMV, is made up of a number of identical units which are held together in strict geometrical regularity. These structural inferences are of importance in understanding such fundamental problems as how viruses live and reproduce themselves and how they may sometimes destroy living biological cells.

THE CARNEGIE INSTITUTION*

THE work of the Institution during the year July 1, 1957-June 30, 1958, is reviewed by the President, Caryl P. Haskins, in the first 45 pages of the book. This is followed by detailed reports of current research and special studies from the seven Departments of the Institution, *viz.*, Mount Wilson and Palomar Observatories (pp. 49-92), Department of Terrestrial Magnetism (pp. 93-166), Geophysics (pp. 167-260), Plant Biology (pp. 261-305), Embryology (pp. 306-72), Genetics (pp. 372-431) and Archaeology (pp. 432-57).

The year under report marks the tenth anniversary of the dedication of the 200-inch Hale telescope on Mount Palomar (June 3, 1948) and also of the agreement of the joint operation of the Mount Wilson and Palomar Observatories by the Carnegie Institution (April, 1948). Hence appropriately enough the report from the Observatories Department reviews the observational programs carried out during the first decade of this joint operation. The connected accounts of Solar observations, Stellar spectroscopy, Gaseous nebulae, Galactic cluster and Galaxies provide instructive reading. As is known there is a guest-investigator program under the joint operation of the Mount Wilson and Palomar Observatories. The purpose of this is to make the unique facilities of the Observatories available, whenever possible, to a wider group of astronomers from other institutions and countries. The report says that under this program during the decade 60 astronomers from 23 institutions in U.S. made 160 visits, and 20 astronomers from 12 other countries made 26 visits.

In the Department of Terrestrial Magnetism wide areas for research have been selected ranging from the study of cosmos and interstellar space to that of living cells. The Department has continued its active programs in radio astronomy, study of solar features by the 88 cm. wavelength (340 Mc.) and cosmic ray investigations with special reference to solar activities. The International Geophysical Year has naturally given a great impetus to the activities of this Department as well as of the Geophysical Laboratory. They participated in three IGY projects, all of them being further extensions of interests already developed in the Departments. The first of these projects concerned the study of the intense band of electric current, called the "electrojet", that circulates

in the upper atmosphere in the region of the earth's magnetic equator. The second is the study of the earth's crust at the high plateau of the Andes, making use of explosions normally set off in the operation of large open-pit copper mines, and observing the waves produced by them. The third is the measurement of the ages of rock minerals by radioisotopes.

The Geophysical Laboratory has brought into full operation a high-pressure apparatus for phase-equilibrium investigations up to 50,000 atmospheres at 1,700° C. simultaneously. Data on the change in melting point of various silicates with pressure, obtained with the apparatus, will help estimating the geothermal gradient within the mantle. The report shows that investigations in experimental petrology have made active progress. During the year Willard F. Libby has carried on a series of researches on geochemistry of fission products, particularly strontium 90. It is a pity that the rock magnetism work was discontinued during the year on account of Dr. John Graham, who was responsible for more than a decade of intensive work in this field, having left the Institution.

In the Department of Plant Biology the nature and mode of action of chlorophyll as it occurs in living plants, as contrasted with the properties of isolated chlorophyll, have continued to be the major interests. Investigations on the absorption spectra of chlorophylls in various algae and chlorophyll synthesis *in vivo* and *in vitro* find a prominent place in the report. In the Department of Embryology progress in the field of immunoembryology has been of main interest and the article "The acquisition of biological specificity" presented by the Director James D. Ebert deserves mention. The focal point of the research program of the Department of Genetics continues to be the study of structure and properties of genes and chromosomes. Few aspects of modern research are more challenging than those of theoretical biology. The Carnegie Institution is deeply concerned with this frontier. Five of the seven departments include in their programs investigations in the life sciences.

The year under report also marks the termination of the work of the Department of Archaeology bringing to a close a record of pioneering achievement in the directed research of the history of the Maya civilization in Middle America, started by Sylvanus G. Morley 45 years ago. In the final report of the Department presented in the Year Book, the past activities of Carnegie Institution in anthropology and archaeology has been reviewed.

* Carnegie Institution of Washington—Year-Book 57. Pp. xi + 497. Price \$ 1.00 (1530, P Street, Northwest, Washington 5, D.C.).

APPLICATIONS OF ELECTROPHORESIS TECHNIQUE IN FORENSIC SCIENCE

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THE forensic scientist is frequently called upon to detect and estimate traces of drugs and poisons of animal, plant or synthetic origin in a great variety of biological material. A large number of tests are published in scientific literature for the detection and estimation of many substances. Most of these chemical and biological tests are non-specific and hence they are of little use when employed directly on the material. It is, therefore, necessary to employ techniques which will resolve complex mixtures into individual components on which the chemical and biological tests can be safely applied to express a correct and definite opinion. Moreover, the quantity of material available for such examination is usually very small. Techniques of electrophoresis and paper chromatography discovered by Tiselius,¹ and Martin and Synge² respectively are invaluable tools in a forensic science laboratory for the separation of individual components in complex mixtures, particularly when the quantity available is very small. It is proposed to deal with the technique of electrophoresis and its applications in this paper.

Tiselius used boundary electrophoresis as a means of separating the protein components of plasma as early as 1937. A large number of workers have modified and used this technique in the analysis of complex protein mixtures and other compounds capable of possessing a charge in an aqueous buffer.

The apparatus necessary for boundary electrophoresis is complex and expensive. Hence paper electrophoresis, which is a very simple technique, first employed by Wieland and Fischer,³ in 1949, has been extensively

used in recent years for the separation of gonadotrophin in urine,⁴ Thyroglobulin in serum,⁵ muscle extracts,⁶ Isoagglutinins⁷ and other materials. Mackay⁸ and Cooper⁹ have carried out the analysis of human serum by this technique. It is not necessary to describe the electrophoresis apparatus and the experimental procedure as they are generally well-known and are in use in many laboratories in India.

The curves are obtained by scanning the papers with a suitable Densitometer. The areas under the Densitometer curves are measured with a Planimeter and the amount of each component is expressed as a percentage of the total area. This percentage will be proportional to the amount of protein provided the technique is standardized very carefully.

This technique has been employed to study the electrophoretic patterns of the blood sera from the different species. The data obtained by Mickinlay and Farmilo¹⁰ for the sera of Horse, Rat, Dog, Sheep, Buffalo, Rabbit, Cow, Pig and Guineapig are given in Tables I and II. If a number of sera are separated on the same sheet of paper it would be possible to obtain a direct comparison under identical conditions. The individual pattern for these species is quite characteristic. The albumin fraction of most species moved at about the same rate in most instances but the albumin fraction of Dog sera was always more mobile than that of any other species studied. The albumin fraction of Guineapig and Rat sera moved at slower rates than the albumin from other species. The data presented here indicate that there are considerable

TABLE I

	Albumin	Globulines								
		α_1	α_2	α_3	β	β_1	β_2	γ	γ_1	γ_2
Horse	.. 44.84	2.34	8.13	..	11.89	..	..	34.74	..	..
Rat	.. 46.10	4.52	10.83	..	20.15	..	..	18.41	..	..
Dog	.. 51.41	4.52	4.52	5.02	..	6.17	18.41	..	..	9.95
Sheep	.. 37.40	2.29	3.16	4.36	..	7.27	9.22	..	36.30	..
Buffalo	.. 32.35	..	26.03	..	8.48	..	..	33.14	..	..
Rabbit	.. 52.30	3.66	9.12	3.98	..	13.10	3.34	14.5	..	..
Cow	.. 46.50	..	13.60	..	..	9.30	..	..	17.80	12.80
Pig	.. 31.60	2.06	16.82	9.05	..	..	17.00	..	..	23.47
Guineapig	.. 58.58	4.11	11.46	..	11.46	..	..	14.39	..	..

TABLE II

Relative mobilities of serum protein components expressed as a fraction of the distance moved by the albumin of the same serum

	Albumin	α_1	α_2	α_3	β_1	β_2	γ_1	γ_2
Horse	.. 1.00	0.79	0.66	..	..	0.47	0.23	0.05
Rat	.. 1.00	0.80	..	0.65	..	0.40	..	0.06
Dog	.. 1.00	0.90	0.78	0.08	0.56	..	0.34	0.09
Sheep	.. 1.00	0.84	0.76	0.62	0.49	..	0.34	0.20
Buffalo	.. 1.00	..	0.74	..	0.54	..	0.23	..
Rabbit	.. 1.00	0.85	0.73	0.65	0.56	0.47	0.21	..
Cow	.. 1.00	0.86	0.72	..	0.51	..	0.36	0.13
Pig	.. 1.00	0.87	0.63	..	..	0.39	..	0.11
Guineapig	.. 1.00	0.85	0.68	..	..	0.39	..	0.11

differences in the electrophoretic patterns of sera from different species of animals and this technique can be used for characterising ani-

mals of different species. Connel¹¹ has demonstrated that the muscle extract from 20 different species of fish gave characteristic electrophoretic patterns. From the medico-legal point of view this technique can be applied for the identification of the species from a blood stain which should be extracted with normal saline before running the electrophoresis.

In recent years, this technique has been used extensively for diagnostic purposes in pathological laboratories attached to hospitals. The characteristic electrophoretic patterns for a number of specific diseases have been worked out by Giri¹² and these have been reproduced in Fig. 1. If a suspect involved in a criminal case happens to be suffering from a particular disease resulting in a characteristic electrophoretic pattern of the blood, it may be possible in rare cases to state that the blood found at the scene of the crime belongs to that particular individual, if there is other circumstantial evidence in favour of this hypothesis.

In order to control the International Drug Traffic, the geographical region of opium in the illicit trade must be known so that the supplies of the drug may be cut off at the source. To this end, the Economic and Social Council of the United Nations in 1948-49 authorised research into devising chemical methods of identifying opium and invited member Governments to participate in such a programme and to provide authentic samples for opium research. The technique of paper electrophoresis has been applied for the detection of the country of origin of opium. Opium samples from different countries were ground in a mortar in 10% acetic acid and filtered. A portion of the clear filtrate was applied to the paper and electrophoresis was carried out in the usual manner. A phosphate citrate buffer at a pH of 5 was used. The alkaloids move to the cathode at this pH and a separation into

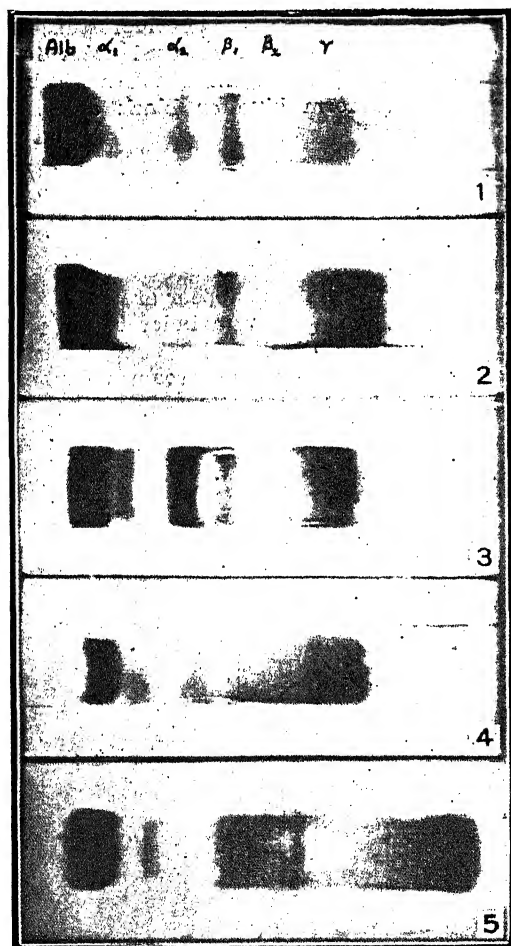


FIG. 1. (1) Normal serum. (2) Cirrhosis. (3) Pulmonary Tuberculosis. (4) Nephritis. (5) Cancer (Stomach).

several fractions is accomplished in a 24-hour run using a potential of 200 volts and a current of 2 m.a., per inch width of paper. The papers were removed, air-dried and photographed under mercury arc ultraviolet light. A photograph of an electropherogram showing the patterns of opium from several different countries of origin are shown in Fig. 2.

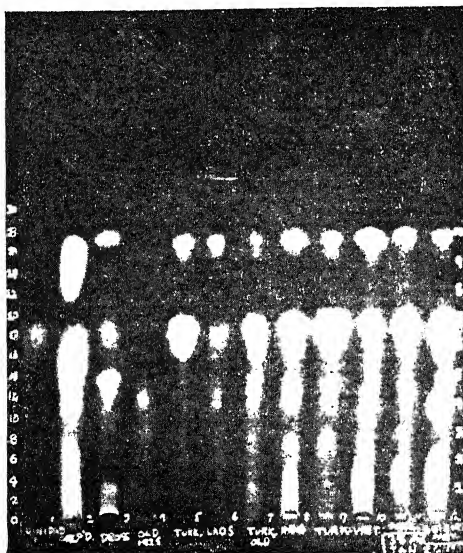


FIG. 2. Shows electrophoretic patterns for opium extracts from opioms of different sources. The electropherograms were developed in a phosphate-citrate buffer at a pH of 5.0 as described in the text.

The data obtained suggests that this technique can be used for distinguishing opium samples of different countries of origin. Combined with the other established methods for determining origin such as the microscopic test, porphyroxine-meconidine value, codeine percentage and ash analysis, this technique of electrophoresis will permit positive origin identification of different samples of opium.

The toxicologist is required to detect the presence or absence of alkaloids and related basic drugs in viscera. The Stas-Otto process involves many steps and the final extract contains large amount of normal tissue extractives which interfere with the chemical and physical tests used in the identification of these drugs. A direct extraction of the tissue with a solvent like ethyl ether followed by the purification of ether extract using the technique of paper electrophoresis have many advantages. By this method, the suspected component can be separated from many normal extractives. The use of sensitive spotting agents makes for increased sensitivity

in detecting or ruling out basic drugs. A quantitative estimation of concentration may be made by comparison of the spots with known standards. The compounds may be recovered in relatively pure state by proper elution and subsequent extraction by immiscible solvent.

After the run of electrophoresis, the dry paper strip is first examined in the dark with the ultraviolet light. Those basic drugs that are strongly fluorescent such as quinine, quinacrine and others are readily located in concentrations of less than 1 microgram. The fluorescence of these drugs is different from those of the normal tissue extractives. Compounds that strongly absorb ultraviolet light will be seen as dark areas on the paper. Strychnine and many other antihistaminic drugs can be located on the paper when present in concentrations of less than 10 micrograms. After marking the areas of fluorescence or absorption, the paper is sprayed with iodoplatinic acid. This reagent reacts with basic compounds to form blue or black areas. As little as 10 micrograms of most basic drugs can be detected with this reagent. For the detection of compounds such as adrenaline, amphetamine, methamphetamine and others, dinitrofluorobenzene is used as a spotting reagent. After first spraying the paper with iodoplatinic acid, any dark areas that appear are cut out and saved for elution. The remainder of the paper is sprayed with a solution of 2% sodium carbonate. This decolorises the brown iodoplatinic reagent and furnishes the necessary alkalinity for the reaction of primary amine with dinitrofluorobenzene. Deep yellow areas appear that remain coloured after dipping the dry paper in dilute hydrochloric acid, if aliphatic amines are present.

Fresh drug-free samples of tissues, especially, liver when carried through the above procedure, will contain small amounts of basic compounds. These compounds appear, when present, as fast moving components. They can be located as a dark spot in ultraviolet light and will form a black spot after spraying with iodoplatinic acid reagent. Another compound will appear after spraying with dinitrofluorobenzene indicating the aliphatic amine. The latter compounds are present in large amounts after putrefaction and will be in such high concentration as to give dark compounds with iodoplatinic acid.

By the employment of this technique, it will be possible to differentiate between the extraneous basic drugs, and the amine that might be

produced by putrefaction. Electrophoresis is, therefore, a valuable tool in the hands of toxicologists for giving a definite opinion as to the presence or absence of a basic drug or poison in viscera, particularly, when putrefaction has already taken place.

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HIGH RESOLUTION RAMAN SPECTRA OF C_2H_4 AND C_2D_4

THE unique importance of the molecular structure of ethylene for valence theory has made this molecule a favourite for spectroscopic studies at high resolution. Early studies of the pure rotational Raman spectrum of ethylene were interpreted in terms of a symmetric and near-symmetric top molecule. These studies have led to the much quoted parameters $r(C-C) = 1.353$ Å, $r(C-H) = 1.071$ Å, and $\angle(H-C-H) = 120^\circ$, for the structure of the ethylene molecule.

Dowling and Stoicheff have given the results of a detailed analysis of the pure Rotational Raman Spectra of C_2H_4 and C_2D_4 under high resolution [*Canad. J. Phys.*, 37 (6), 703-21]. The spectra were photographed in the second order of a 21 ft. grating. The resolution achieved was high enough to warrant analysis based

on the non-rigid asymmetric top. Several lines were identified as single transitions and their analysis has led to an accurate evaluation of the rotational constants for the ground states. The structural parameters of ethylene obtained from these constants are given below, compared with their values obtained by infra-red spectroscopy and electron diffraction method.

	$r_0(C-C)$	$r_0(C-H)$	$\angle H-C-H$
Raman ..	1.339 ± 0.002 Å	1.086 ± 0.003 Å	$117^\circ 34'$ $\pm 20'$
Infra-red ..	1.337 ± 0.003	1.086 ± 0.003	$117^\circ 22'$ $\pm 1^\circ$
Electron diffraction	1.334 ± 0.003	1.085 ± 0.005	116° $\pm 1^\circ$

NATIONAL PHYSICAL LABORATORY (ENGLAND)—ANNUAL REPORT FOR 1958*

THE Report outlines the recent reorganization at the NPL and the new trends in its research work. The replacement of three of the old Divisions by the new Divisions of Applied Physics, Basic Physics and Standards has enabled the Laboratory to plan research into new fields. The new Basic Physics Division is equipping itself to begin work mainly devoted to the relation between the macroscopic properties of materials and their structure on a molecular scale. In the Applied Physics Division, work has begun on radio-carbon dating and a national centre for neutron source standardisation is being formed. A new item in the Standards Division is the accurate determination of the gyromagnetic ratio of the proton which will open the way to precise measurement of strong magnetic fields and

hence to the accurate determination of a number of important fundamental constants.

Other new aspects of the programme include the increasing attention of Aerodynamics Division to the behaviour of gases at the high temperatures associated with high speed flight, and to the development by the Control Mechanisms and Electronics Divisions of new components for very high-speed computers. The Light Division has made progress with some interesting new ideas in the application of gratings to linear and angular measurement and to the control of machine tools. The Metallurgy Division has been concentrating particularly on fine structure of metals, movements of dislocations and their relation to physical and mechanical properties. A group is being set up in the Mathematics Division to consider the theoretical aspects of experimental work being carried out in other Divisions.

* Published for D.S.I.R. by H.M.S.O., price 8s.

LETTERS TO THE EDITOR

A SMALL FURNACE FOR USE WITH SEIFERT X-RAY DIFFRACTOMETER

A NUMBER of high temperature powder cameras employing films for recording X-ray lines are described in literature; but hardly a few¹⁻³ furnaces are described which can be used with a recording diffractometer. Moreover the materials recommended for use in such furnaces are not obtainable in ordinary laboratories. The furnace described in this note is assembled from materials available in our laboratory and has been designed for Seifert X-ray diffractometer which employs Bragg-Brentano focussing.

The furnace, Fig. 1, consists of a piece B of size 2" × 2" × 0.3" cut from a hardened and

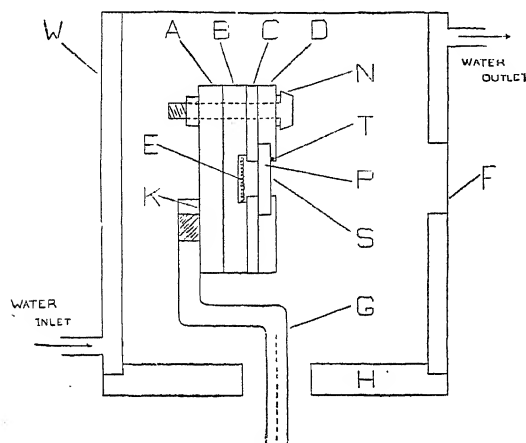


FIG. 1

burnt out brick from a spoiled electric muffle-furnace. It has a groove of about one inch diameter in the middle. The heating element E consists of a coiled coil spiral of platinum + 10% rhodium wire of length 6' and diameter 0.3 mm. The spiral is fitted in the groove in B. A, C and D are asbestos sheets. A platinum plate P of about 1" diameter and thickness 0.4 mm. is pressed between B and C. The thickness of C is kept small so as to leave a small gap between the heating element and the plate. This ensures quick rise of temperature and prevents short-circuiting. The powder under investigation is pressed on the front surface S of the plate. The whole assembly is kept together by four screws N fitted at the four corners of the furnace. A platinum-platinum + 10% rhodium thermocouple is put

at the point T. The glass rod G holds the furnace at its upper end while its lower end fits into the central hole of the diffractometer plate. The glass rod serves as an insulator between the furnace and the diffractometer plate. A circular brass plate H is fixed on the diffractometer plate at its centre. On this brass plate stands a cylindrical jacket W in which water is circulated in order to ensure uniformity of conditions. The water jacket has an opening in front of the platinum plate P for the entrance and exit of X-rays. The opening is covered with a thin aluminium foil F.

The plate of the specimen can be made to coincide with the vertical axis of rotation (shown dotted) by inserting packings at K between the glass rod and the sheet A. The furnace has been used up to a maximum temperature of 800° C. The same furnace with slight modifications can be used with a back reflection camera.

Some of the requirements of a good furnace to be employed with a diffractometer are: (i) small size so as to avoid rise of temperature of diffractometer itself, (ii) quick response,

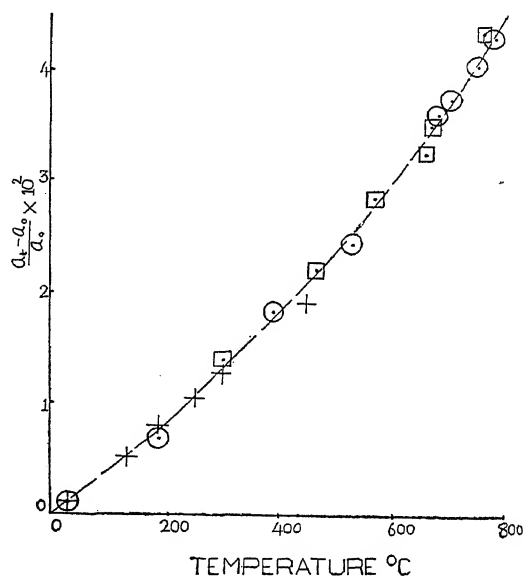


FIG. 2

— — — dilatometric observations (smoothed) Eucken and Dannöhl⁴; ○ : present measurements; □ : Fischmeister⁵; + : Basu and Maitra⁶.

(iii) constancy of its calibration curve. The present furnace satisfies these requirements. Typical observations on NaCl up to its melting point are given in Fig. 2 in which the relative increase of the cell constant referred to its value at 0° C. is plotted against temperature.

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ELECTRO-OSMOSIS IN ION-EXCHANGE RESIN MEMBRANES

THERE are four recorded examples¹⁻⁴ of measurements of electro-osmosis in ion-exchange resin membranes. Lakshminarayanaiah⁴ has covered a wider range of conditions measuring electro-osmosis through 5%, 10% and 15% cross-linked polymethacrylic acid (PMA) resin membranes in various alkali metal forms and through sulphonated phenol-formaldehyde (PSA) resin membranes in Na and K forms. A typical result for the system 0.01 N NaCl-Na (PSA) membrane-0.01 N NaCl is recorded (Fig. 1).

Unambiguous explanation of the phenomenon depicted by the curve is not forthcoming, although the following tentative and qualitative explanations have been offered:

(a) It is believed that there are two types of current carriers in the resin phase. At low current densities, ions in the diffuse part of the double layer carry the greater part of the current and at high current densities, all the counter ions participate giving a limiting value to the volume of liquid transported through the membrane for the passage of a Faraday of Current.

(b) Variation of electro-osmosis with current density is due to some chemical change in the membrane, probably concentration polarisation⁵ induced by electrolysis. This phenomenon, though it has not been thoroughly investigated in these systems, has been shown to be not the cause. It is based on the evidence of electrical conductance of H-form and Na-form PMA and PSA resins.⁴

(c) The heterogeneous character of the membrane is responsible for the peculiar behaviour. The membrane has pores of various sizes charged differently. At low currents, the uncharged or slightly charged pores seem to be selectively active electro-osmotically and at high currents, every pore is active giving an average value for the electro-osmotic flow of liquid through the membrane.

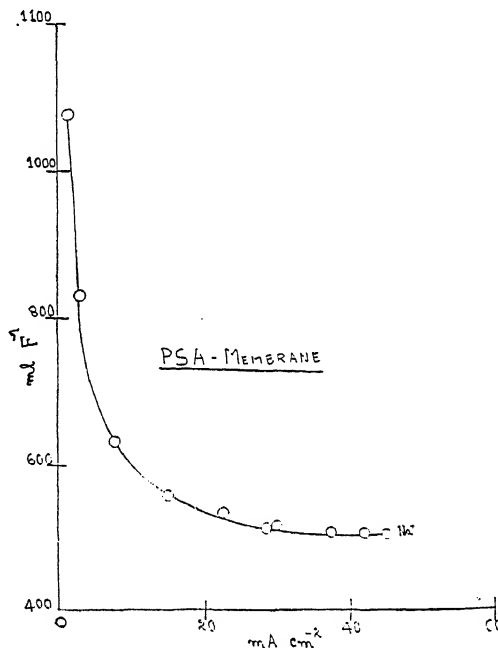


FIG. 1

Though explanation (b) has been dismissed it needs thorough investigation. Explanation (a) implies an apparent breakdown of Ohm's law. It is important to establish if these systems, solution \rightleftharpoons Membrane \rightleftharpoons solution, obey Ohm's law or not, although the electrical conductance of these systems have been measured accurately employing the A.C. technique.⁶⁻¹⁰

Using the direct current method of Gordon and Gunning,¹¹ resistance of the system, solution \rightleftharpoons Na-form PSA membrane \rightleftharpoons solution, has been measured as a function of current density employing 0.01 N, 0.1 N and 1.0 N NaCl external electrolyte solutions. With 0.01 N NaCl external solution, the resistance of the system rose significantly with increase of current due to depletion of ions in the region of the probe electrodes P_1 and P_2 (Fig. 2). This was eliminated by flowing the solution over the membrane surface. In all the measurements, this technique was employed.

Stout reversible Ag-AgCl electrodes R_1 and R_2 carried the current through the system. For

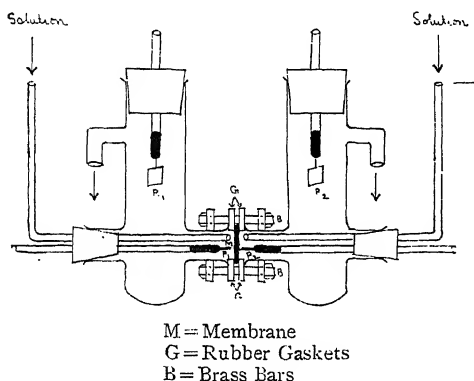


FIG. 2

fixed positions of Ag-AgCl probes, the resistance remained constant in each case (Table I)

TABLE I

External solution	Current density mA/cm. ²	Resistance Ω
0.01 N NaCl ..	0.14	516
	0.19	515
	0.33	518
	0.45	517
	0.64	519
0.1 N NaCl ..	0.11	79.0
	0.36	78.8
	0.63	78.9
	0.93	78.8
1.0 N NaCl ..	0.09	15.0
	0.17	14.8
	0.32	14.8
	0.44	14.7
	1.38	14.8

irrespective of the current passed through, confirming the applicability of Ohm's law to these systems. So postulation of the existence of two types of ions in the membrane phase to explain the electro-osmotic curve (Fig. 1) becomes unreal.

The other probable factor, viz., the heteroporesity of the resin phase, causing the observed electro-osmotic flow, is under study.

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ANION EXCHANGE RESINS AS CATALYST IN THE SYNTHESIS OF PYRIDINE DERIVATIVES

ANION exchange resins are widely used as catalyst in numerous organic reactions. In the synthesis of pyridine derivatives, the use of anion exchange resins as catalyst has not been reported so far. It is now found that cyanoacetamide condenses with acetylacetone in presence of Amberlite IRA-400 to give 3-cyano-4:6-dimethyl-2-pyridone in good yield. The experimental procedure is as follows:—

Amberlite IRA-400 (A.G.) was washed with 5% sodium hydroxide solution (5 to 6 times the volume of the resin) in a Buchner funnel. The resin was rinsed with distilled water until the washings were neutral, and was air dried before use. Amberlite IRA-400 (4 g.) was added to a saturated solution of cyanoacetamide (4.2 g) and acetylacetone (5 g.) in alcohol and the reaction mixture was refluxed for 3 to 4 hr. on steam bath. The reaction mixture was then filtered hot to remove the resin. The filtrate, on cooling, gave a crystalline product. This was collected on filter, washed with cold alcohol and crystallized from alcohol in white shining needles. M.p. and mixed m.p. with an authentic sample of 3-cyano-4:6-dimethyl-2-pyridone¹ was 289°. Yield 5 g.

Synthesis of other pyridine derivatives using the anion exchange resins as catalyst is in progress.

I am thankful to Prof. Suresh M. Sethna for his guidance and help.

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M.S. University of Baroda,
Baroda-2, April 6, 1959.

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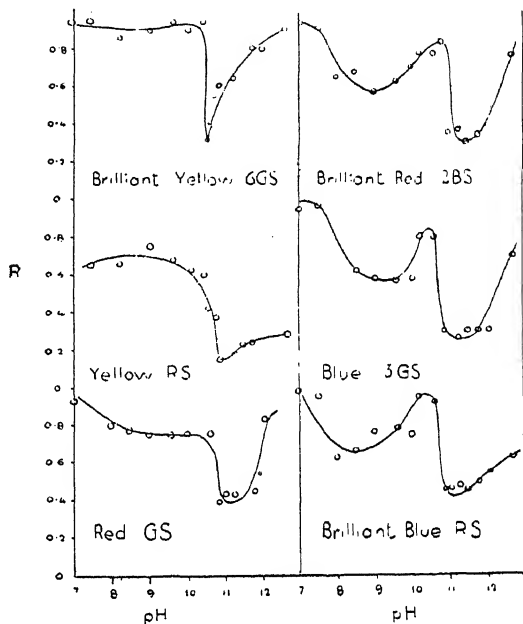
A CHROMATOGRAPHIC STUDY OF SOME REACTIVE DYESTUFFS

RECENTLY chemically reactive dyestuffs have been put on the market by I.C.I., Ciba and Farbwerke Hoechst under the trade names Procion, Cibacron and Remazol respectively. These dyes¹⁻³ all have the common characteristic of forming a chemical linkage with cellulose but only in alkaline media, the rate and extent of reaction being dependent on pH and temperature. In alkaline solutions the dyes also undergo hydrolysis forming what are called inactive dyes and which have practically no substantivity for cellulose, a property which is also shared by the active dyes when in neutral solutions.

In view of these unique properties of reactive dyes it was thought that a circular paper chromatographic study of these dyes as a function of pH using cellulose filter-paper would lead to some interesting results. Chromatograms under identical conditions were therefore taken on 12.5 cm. diameter Whatman No. 1 filter-paper discs using Rutter's method.⁴ The developing solutions were buffer mixtures covering the pH range 6.9-12.7. Cold brand Procion dyestuffs were used in these experiments. These highly reactive dyestuffs contain two labile chlorine atoms of relatively high reactivity and are formed by linking cyanuric chloride with water soluble azo or anthraquinone dyes that contain an amino group. These two labile chlorine atoms are available for combination with cellulose.^{1c} 0.2% aqueous solutions of the commercial dyes were used in all the experiments. After marking the positions of the different zones the chromatograms were soaped and boiled in order to remove inactive hydrolysed dye. R values for chemically combined dye were measured in all cases, R being defined as the ratio of distance travelled by dye to that travelled by the solvent front in the same time. The variation of R with pH is presented graphically in Fig. 1.

During the development of the chromatogram the adsorbed dye can react partly with the cellulose of the filter-paper forming a chemically fixed coloured zone, get hydrolysed partly to the inactive form and while the developing solvent advances, unreacted active dye and the hydrolysed inactive dye will diffuse out forming outer coloured zones of further chemically combined dye and loosely bound physically adsorbed inactive dye respectively. The Procion dyes studied show this expected behaviour when chromatographed. The extent of spread of the zones and the formation of

more than one chemically combined zone is dependent on the relative reactivities and affinities of the dye for cellulose as well as the pH of the eluting solvent.



VARIATION OF R VALUES WITH pH FOR PROCION DYES. TEMPERATURE: 23° ± 1°

FIG. 1

From Fig. 1 it is clear that R has minimum values depending on pH. For Procion Yellow RS, Brilliant Yellow 6GS and Red GS there is a single sharp minimum value for R and it is interesting to note that the pH corresponding to this minimum R value is almost identical with the optimum pH value for percentage maximum fixation of the dye on cotton in the same temperature range.⁵ In the case of Procion Brilliant Red 2BS, Brilliant Blue 3GS and Blue RS, R is a minimum at two or more pH values. These minima are not sharp and also there is no specific correlation between the value of optimum pH for maximum percentage fixation and the pH corresponding to a minimum R value, but it is noteworthy that Procion Brilliant Red 2BS has peak fixation values at more than one pH value.⁵ At high alkali concentration it is clear that the reaction between these dyes and cellulose is quite complex. A general conclusion which can be drawn from the data obtained is that the rate of reaction with cellulose is governed by several factors and is not always instantaneous,^{1c} since zones of chemically combined dye

having high R values are obtained both at low and high pH values. A detailed study of these and other aspects of this investigation will be published elsewhere.

The authors' thanks are due to Dr. B. K. Vaidya for his keen interest during the course of this work and to Messrs. I.C.I. Ltd., Bombay, for the supply of free dyestuff samples.

ATIRA, Ahmedabad 9,
May 9, 1959.

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TETRAHYDROXYQUINONE AS AN ANALYTICAL REAGENT AND ITS RELATIONSHIP WITH SODIUM RHODIZONATE

Sodium rhodizonate is an important reagent; it gives colour reactions with a large number of cations¹ and has been largely used in chromatographic spotting. Tetrahydroxyquinone is also known to give coloured products with Ba^{++} , Pb^{++} and Sr^{++} .^{2,3}

Previous workers have described potassium and sodium rhodizonate as a violet crystalline compound and sodium tetrahydroxyquinone as a dark green crystalline compound.^{4,5} Hoglan and Bartow⁶ prepared both sodium tetrahydroxyquinone and sodium rhodizonate by the oxidation of inositol. These salts on acidification gave bluish black crystals, which gave the same benzoyl derivative, m.p. 266-70°. The above workers therefore doubted whether they are two different compounds.

We found that tetrahydroxyquinone reacts with a large number of cations, viz., Pb^{++} , Tl^{+} , Ag^{+} , Hg^{++} , Ba^{++} , Sr^{++} , Ca^{++} , Mg^{++} , Bi^{+++} , Cd^{++} , Cu^{++} , Zn^{++} , Sn^{++} , and UO_2^{++} and the colour reactions are the same as described for sodium rhodizonate.¹ It is very unlikely that two different compounds should give the same colour reactions with a large number of cations. We, therefore, concluded that tetrahydroxyquinone and rhodizonic acid are not two different compounds. Further we analysed a dried pro-analysis sample of sodium rhodizonate (E. Merck) and the results indicated 1% hydrogen corresponding to sodium tetrahydroxyquinone.

The following colour reactions have also been noted in neutral solutions. ZrO_2^{++} red; Th^{++++} blue; Ce^{+++} blue (Ce^{++++} oxidises the reagent).

Further, a solution of the so-called sodium rhodizonate is readily decomposed¹ being alkaline. A solution of tetrahydroxyquinone is more stable and we have observed that in the presence of a little acetic acid and formaldehyde it remains unchanged for about a week.

Our thanks are due to Prof. T. R. Seshadri for helpful discussions.

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BEHAVIOUR OF A MIXTURE OF NITROUS OXIDE AND HYDROGEN UNDER SPARK DISCHARGE

THE thermal reaction between nitrous oxide and hydrogen has been extensively studied.¹⁻⁴ Studies in the production of a periodicity effect under silent discharge,^{5,6} suggested the desirability of the present extension of work, viz., to investigate the reaction under spark discharge. The following experiments were conducted to find out whether a periodicity effect in the pressure vs. duration of exposure curve, similar to that observed under the silent discharge, was produced under the spark discharge.

The experimental procedure was essentially similar to that adopted earlier.⁵ The ozonizer was replaced by a glass bulb of about 50 c.c. capacity attached to the capillary manometer by a stop-cock and to the mixture reservoir ($\text{N}_2\text{O} + \text{H}_2$) by another stop-cock. The bulb was evacuated by the Töpler.

The results are given in Table I. The reaction under spark discharge shows an overall diminution of pressure to a constant minimum. There is a marked limitation in respect of the initial pressure of the reaction mixture (72 mm. Hg) beyond which the reaction tends to become explosive; this limiting pressure would depend upon the sparking distance, as it determines the relevant field. At higher pressure, the defonation is attended by a sudden

TABLE I

Spark length = 7 mm. (Aluminium disc 1 cm. in diameter)

Ratio N ₂ O/H ₂ (By volume at N.T.P.)	Initial pressure of N ₂ O + H ₂ mixture (mm. Hg)	Applied potential minimum volts (r.m.s.)	Frequency of the A.C. supply c/s	Pressure diminution (net change)	
				Obs. (mm. Hg)	Cal. * (mm. Hg)
24.2					
75.8	72	1900	50	57	54 (no explosion occurred)
do.	85	2400	do.	66	65
do.	102	2700	do.	82	77
do.	112	2900	do.	90	85
do.	120	3200	do.	92	91
do.	134	3500	do.	107	102
51.2					
48.8	200	4800	50	110	102
do.	252	5100	do.	132	129
do.	247	500	500	127	126
do.	263	500	do.	146	135
70.4					
29.6	149	3700	50	108	105
do.	242	5300	do.	181	170

* For the reaction : N₂O + H₂ = N₂ + H₂O (Liquid).

change of pressure, a characteristic click and a flash of light. These features are accentuated at still higher pressure for the same gaseous composition. Final pressure has been recorded after allowing the bulb to cool for about two hours. Periodicity effect is not observed even when the gaseous mixture contains either an initial excess of nitrous oxide or hydrogen or when the ratio of the two components is roughly equal to 1 : 1. The reaction under spark discharge is principally attributed to the thermal action of the spark (as distinct from its associated electrical influences) since it yields nitrogen and water as its final products which are identical with those observed in the thermal change.^{7,8} N₂O + H₂ = N₂ + H₂O.

The author wishes to express sincere thanks to Dr. S. S. Joshi, Head of Chemistry Department, Benares Hindu University, for his kind interest and helpful suggestions during the course of this research in his laboratory.

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THE MECHANISM OF OXIDATION OF SECONDARY ALCOHOLS BY CHROMIC ACID

CHROMIC acid oxidations are generally considered to involve essentially a dehydrogenation of the carbon compound oxidised, and the generally accepted mechanism is the one put forward by Westheimer⁶ on the basis of his studies with isopropyl alcohol. This general acceptance has even led to devious reasoning to explain away any apparent contradictions in a few cases. The essential features of this mechanism are (i) the preformation by a rapid reversible reaction of an acid ester, a monoalkyl chromate, followed by (ii) interaction with a base, e.g., water, in the slow rate-determining step. In this last step, it is assumed that the chromium is reduced to a tetravalent compound and the hydrogen atom at the secondary

carbon atom carrying the hydroxyl group is removed as a proton.

While the rupture of the secondary C-H bond in the rate-determining step is on fairly certain grounds,⁷ one cannot readily accept the position that the isolation of a neutral ester of the alcohol with chromic acid is adequate for postulating ester formation as the crucial initial step followed by the subsequent decomposition. The validity has also been questioned by Rocek⁵ who has suggested an alternative cyclic mechanism. Further doubt on the mechanism is cast by the clear observations that the reaction is faster in media containing less water as in acetic acid of various dilutions. We are unable to accept the explanations offered for this abnormality.⁸

In a previous communication¹ we had indicated the complex nature of the reaction. We find that the reaction is slowest in 30% acetic acid and fastest in 80% acetic acid in the range of solvent compositions. The order of reactivity closely follows the conditions for stabilising carbonium ions.² It was anticipated that the study of a series of secondary alcohols would provide the answer. The results of these studies clearly substantiate our anticipations.

The formation of a carbonium ion in the rate-determining step together with the removal of the C-H hydrogen at the secondary carbon atom as an anion, removes some of the anomalies noticed. Thus the observations of Kwart and Francis³ on the role of substituents in the oxidation of *p*-substituted alpha-phenylethanols are in the proper order $\text{CH}_3\text{O}-> \text{tert C}_4\text{H}_9-> \text{CH}_3-> \text{H}-> \text{Cl}-> \text{NO}_2-$ and the nitro group does not present any abnormality to be explained away with difficulty by adopting Westheimer's mechanism as the authors have done. Similarly Ogata, Fukui and Yuguchi⁴ report the order $\text{H}-> \text{Br}-> \text{Cl}-> \text{CN}-> \text{NO}_2$ in the oxidation by chromic acid of *p*-substituted toluenes. This also conforms to the order to be expected for removal of hydrogen as an anion in the rate-determining step.

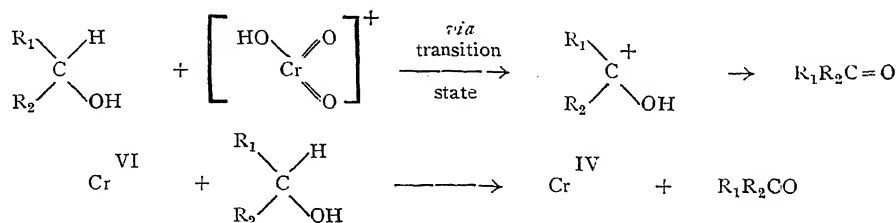
The mechanism of esterification and hydrolysis is now fairly well established and it is generally found that this involves an activation energy of the order of 16,000 calories while in the series of compounds investigated, this is invariably about 2,000 calories less. While one can accept the formation of an ester in a concurrent reaction, it is obvious that esterification need not be a prerequisite for the oxidation (cf. Rocek⁵).

TABLE I
Rate of oxidation of secondary alcohols at 40° C. ($k_2 \times 10^5$)

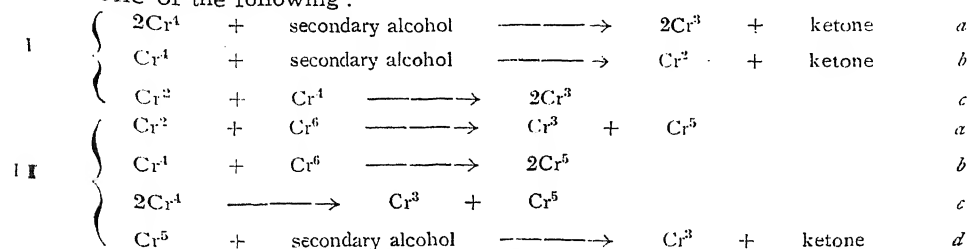
Alcohol	Solvent composition : % Acetic acid (v/v)					
	30	40	50	60	70	80
Propan-2-ol	0.9822	1.985	3.9047	8.353	19.03	..
Butan-2-ol	1.7146	3.4494	7.152	14.45	34.67	..
Pentan-2-ol	2.817	4.786	9.348	18.704	42.58	..
Octan-2-ol	..	..	..	16.60	38.02	99.19
Alpha-phenyl ethanol	..	..	2.422	4.610	10.123	23.22
Benzhydrol	..	..	6.026	8.640	18.20	50.12

All rate constants are in units of mol/l., sec.⁻¹ $\times 10^5$ and refer to a second order reaction at constant hydrogen-ion concentration and constant ionic strength.

The following tentative mechanism for the oxidation may be suggested to account for all the behaviour so far observed :



and by one of the following:



is as yet inadequate as to the process which the chromium is reduced to the state by the reducing agent. Full details published shortly elsewhere.

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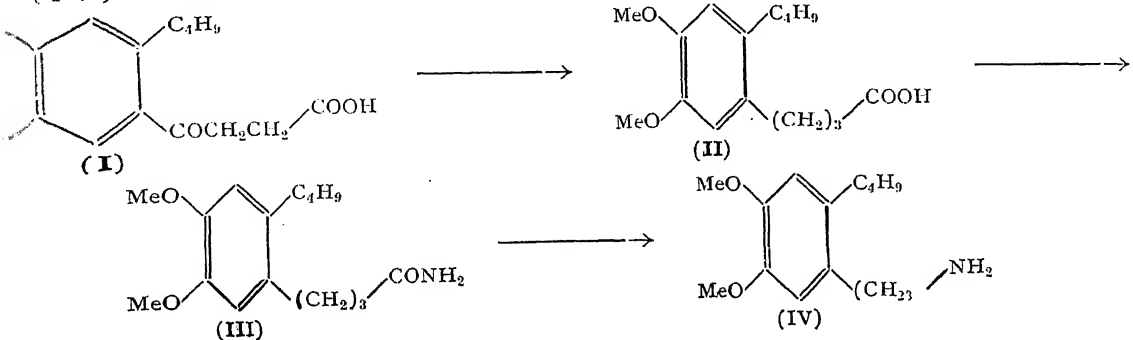
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NTHESES OF γ -(2-*n*-BUTYL-4:5-DIMETHOXYPHENYL)-*n*-PROPYLAMINE

(2-alkyl-4:5-dimethoxyphenyl)-ethylamines were prepared by Kachru and Pathak¹ and were tested *in vitro* for amoebicidal activity by Kaushiva² who observed greater amoebicidal activity in β -series. It would be desirable to determine the effect on the amoebicidal activity if the amino group is further removed from the nucleus by one more C-atom.

The synthesis of γ -(2-alkyl-4:5-dimethoxyphenyl)-propylamines was taken up; with alkyl groups as methyl, ethyl and *n*-butyl have already been described³; that of γ -(2-*n*-butyl-4:5-dimethoxyphenyl)-*n*-propylamine (IV) is recorded here.



3 : 4-Dimethoxy-*n*-butylbenzene, prepared according to the procedure adopted by Kachru and Pathak,¹ was condensed with succinic anhydride in nitrobenzene in the presence of anhydrous aluminium chloride to yield β -(2-*n*-butyl-4:5-dimethoxybenzoyl)-propionic acid (I), crystallised from dilute alcohol, m.p. 100° (Found: C, 65.36; H, 7.53. $\text{C}_{16}\text{H}_{22}\text{O}_5$ requires C, 65.31; H, 7.48%). Likewise β -(2-*n*-amyl-4:5-dimethoxybenzoyl)-propionic acid, m.p. 98° and β -(2-*n*-hexyl-4:5-dimethoxybenzoyl)-propionic acid, m.p. 92° were also prepared. Clemmensen reduction of the keto acid (I) with toluene as the solvent gave γ -(2-*n*-butyl-4:5-dimethoxyphenyl)-*n*-butyric acid (II), b.p. 218°/1 mm., m.p. 66° (Found: C, 68.45; H, 8.39. $\text{C}_{16}\text{H}_{24}\text{O}_4$ requires C, 68.57; H, 8.52%). Correspondingly γ -(2-*n*-amyl-4:5-dimethoxyphenyl)-*n*-butyric acid, m.p. 81° and γ -(2-*n*-hexyl-4:5-dimethoxyphenyl)-*n*-butyric acid, m.p. 83° were obtained. Out of these three acids only (II) provided the amide (III), m.p. 103° (Found: N, 5.20. $\text{C}_{16}\text{H}_{25}\text{O}_3\text{N}$ requires N, 5.01%), other acids resinified both during the preparation of the acid chlorides and the ammonium salts. The amide (III) by Hofmann reaction of treatment with sodium hypochlorite yielded the desired amine (IV), picrate m.p. 137°, the amine hydrochloride crystallised from ethyl acetate, m.p. 202°, with decomp. (Found: C, 62.73; H, 9.13; N, 4.74. $\text{C}_{15}\text{H}_{26}\text{O}_2\text{NCl}$ requires C, 62.61; H, 9.04; N, 4.87%). Conversion of γ -(2-*n*-amyl-4:5-dimethoxyphenyl)-*n*-butyric acid and its *n*-hexyl analogue into the analogous amines corres-

ponding to (IV) failed even by Curtius and Schmidt reactions.

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by the modified volumetric method and those obtained gravimetrically by the method adopted by Badeeva.³

TABLE I
Fluorine content in mg.

	Volumetric method	Gravimetric method
Soln. I ..	30.4 30.4	30.5 30.4
Soln. II ..	47.4 47.4	47.5 47.4

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ON THE VOLUMETRIC ESTIMATION OF FLUORIDE BY THORIUM NITRATE

THE method of Willard and Winter¹ for the volumetric estimation of fluoride by thorium nitrate using alizarin red S as indicator is a general laboratory procedure. However, the difficulty in noting the end point in this volumetric estimation cannot be over-emphasized.² The adsorption of the red coloured complex on the thorium fluoride precipitate gives rise to the difficulty in observing sharp change in colour from yellow to pink at the end point. In the present note a modified method is suggested to overcome the difficulty. It consists in filtering the thorium fluoride precipitate before the end point is reached. This eliminates the adsorption of the red coloured thorium complex with alizarin red S on the fluoride precipitate. It has been found that the end point becomes unmistakably sharp after filtration.

It is necessary when applying this method of estimation of fluoride that either the approximate volume of thorium nitrate solution (N/10) required be known or a rough titration be carried out till red colour appears. For accurate titration, a volume which is short of the approximate volume by 2 to 3 ml. is added straight from the burette to the fluoride solution in the conical flask, maintained at pH 2.9 to 3.4 using monochloro acetic acid-sodium monochloro acetate buffer (*loc. cit.*). The thorium fluoride precipitate formed is filtered off. The flask and the precipitate are next washed into the filtrate with small quantities of the solution of monochloro acetic acid-sodium monochloro acetate having the same pH as the filtrate. The indicator is added and the titration continued. The end point becomes sharp and can be noted with a drop.

Estimations of fluoride, for two solutions in duplicate, carried out by us are shown in Table I. The figures show the values obtained

It can be seen that the modification involving just one filtration before the end point makes the method reliable.

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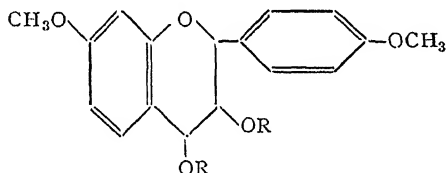
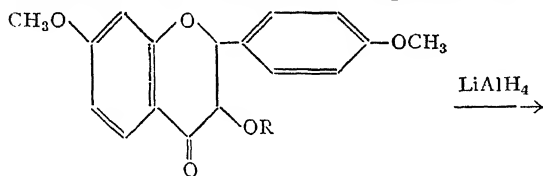
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SYNTHESIS OF CRYSTALLINE LEUCOANTHOCYANIDINS RELATED TO GUIBOURTACACIDIN

RECENTLY Roux¹ has indicated the presence of a new leucoanthocyanidin "Guibourtacacidin" in the species of genus *Guibortia* and has suggested it to be 7:4'-dihydroxyflavan-3:4-diol. The present communication reports the synthesis of flavan-3:4-diols isomeric in position "4" and having the above basic structure.

7:4'-Dimethoxydihydroflavonol (I), m.p. 133° required for the purpose was prepared by the procedure described by Joshi and Kulkarni.² On reduction of the above dihydroflavonol with lithium aluminium hydride a mixture of flavan-3:4-diols with a melting point range 113-21° was obtained. The mixture could be conveniently separated by acetylating it and crystallising the diacetates. The diacetate (III), m.p. 132° (Found: C, 65.6; H, 6.0; C₂₁H₂₂O₇ requires C, 65.3; H, 5.7%) separated out first. On hydrolysis with alcoholic sodium carbonate the corresponding diol (II), m.p. 114-15° (Found: C, 67.1; H, 6.2; C₁₇H₁₈O₅ requires C, 67.5; H, 6.0%) was obtained. The mother liquor was then similarly hydrolysed and the mixture of

diols now richer in the other isomer was obtained. It was crystallised several times from alcohol when another diol (IV), m.p. 136° (Found: C, 67.8; H, 6.2; $C_{17}H_{18}O_5$ requires C, 67.5; H, 6.0%) was obtained. It was characterised by preparing the dibenzoate (V), m.p. 159° (Found: C, 72.7; H, 5.0; $C_{31}H_{26}O_7$ requires C, 72.9; H, 5.0%). Both these diols (II and IV) on warming with alcohol and hydrochloric acid gave pink colour³⁻⁶ which changed to yellow on keeping and a violet colouration with concentrated sulphuric acid.



III R = -COCH₃, m.p. 132°

IV R = H, m.p. 136°

V R = -COC₆H₅, m.p. 159°

The diol (II) could be obtained in a quantitative yield on reduction of the dihydroflavonol with sodium borohydride. On the basis of the stereospecificity⁷ of reducing agents and the hypothesis of Joshi and Kulkarni,⁸ this diol is assigned 2:3-*trans*-3:4-*cis* configuration and is most probably identical with "Guibourtacacidin" dimethyl ether. The other diol could then have 2:3-*trans*-3:4-*trans* configuration.

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ON THE BIOLOGICAL ESTIMATION OF ADRENALINE AND THE OXYTIC PRINCIPLE OF PITUITARY POSTERIOR LOBE EXTRACT WHEN PRESENT IN A MIXTURE

FOR cardiac or nephritic dyspnoea, collapse and bronchial asthma a mixture of adrenaline and pituitary posterior lobe powder extract is often used. Strengths of adrenaline and the oxytocic activity of extract of posterior pituitary lobe powder are generally found to be of the order of 0.5 mg. and 5 I.U. per ml. respectively. Both being vasopressor in action, it is difficult to estimate the potency of such a preparation by the customary biological assay method. As such an attempt was made to separate and subsequently estimate each component in such a pharmaceutical preparation. This has been made possible by the application of ion-exchange chromatography.

An aliquot (2 ml.) of a preparation containing adrenaline (0.5 mg. per ml.) and pituitary (5 I.U. per ml.) was percolated through a column (5 × 0.5 cm.) of Zeokarb 215 (H. form), followed by distilled water to make the volume of the percolate to 25 ml. Adrenaline was adsorbed on the resin, the pituitary oxytocic principle separating out in the percolate.

The percolate was then diluted 8 times to have 0.05 I.U. per ml. and subjected to biological assay on the uterus of virgin guineapig in comparison with a standard preparation containing 0.05 I.U./ml. Results of the assay indicated complete recovery of the principle.

Adrenaline was eluted from the resin with ice-cold 3 N hydrochloric acid (10 ml.), followed by distilled water (5 ml.). The eluate was adjusted to pH 2.5 with sodium hydroxide (about 10%) in cold (0-5°C.) and the final volume made up to 25 ml. It was then assayed biologically on a spinal cat against a standard preparation containing adrenaline chloride (1:25,000). The recovery was almost complete. Similar experiments were repeated with solution containing adrenaline tartrate or adrenaline malate admixed with pituitary extract and it was found that here also the two constituents in a mixture could be easily estimated within experimental error.

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April 14, 1959. S. K. DUTTA.

A NOTE ON TWIN LAWS IN PLAGIOCLASE FELSPARS FROM CERTAIN GRANITIC AND ASSOCIATED ROCK TYPES OF NANDI

PETROLOGICAL literature of last thirty years abounds in many references to the nature and origin of twins in plagioclase feldspars. In recent times workers like Gorai (1951),² Suwa (1956),⁵ Turner (1951)⁶ have given thought to the distinctiveness of particular twin law or laws in a series of rocks. In the present study an attempt is made to record some of the twin types encountered in plagioclase feldspars of granites and associated rock types from Nandi Hills, situated in Kolar District, Mysore State (Long. 77° 40', Lat. 13° 22').

The rocks around Nandi are made up of medium to fine grained grey granites, granodiorites and gneissic-granites. Besides this a few xenolith patches of amphibolites were also noticed. About 35 representative samples were collected and 80 thin sections were prepared out of them. 226 feldspar grains from granites, granodiorites, gneissic-granites and amphibolites were analysed for anorthite content and twin laws, according to the methods of Reinhard (1931).⁴ The twin axes were located by using Nikitin and Berek construction. The above observations, as far as possible, were further checked by noting the angles between twinning axis and optic elasticity axes. The observed values of anorthite content are shown in Table I.

TABLE I
Nature of plagioclase feldspar

Rock types	Frequency of twinning (no. of grains)						Anorthite %
	Albite	Manebach	Pericline*	Albite-ala B	Manebach-ala (aktine)	Carlsbad-albite	
Coarse grained grey granites	4	..	..	8	..	..	20-25
Medium grained grey granites	13	..	..	26	..	..	22-28
Fine grained grey granites	8	..	..	10	..	..	22-25
Granodiorites ..	17	..	4	22	..	..	20-28
Gneisses ..	48	..	8	24	..	..	15-28
Amphibolites	4	8	..	4	14	4	28-40
Total	..	94	8	12	94	14	4 Grand Total 226

* Pericline twins are seen across the albite twins. Hence they show albite-pericline (complex) twin laws.

According to Gorai albite-alaB twins are characteristic of igneous rocks and among plutonic rocks the albite-alaB twins show 25 to 49% anorthite. Coulson (1932)¹ also remarks that 33% anorthite is more favourable for the formation of albite-alaB twins.

However, the present study discloses the following features: (i) that albite-alaB twins are common in granites and granodiorites; (ii) in gneisses, the albite twins predominate; (iii) the centre of gravity of the albite-alaB twins is between 22 to 26% of anorthite and its optics are completely sensitive to the variation of chemical composition; and (iv) among composition planes (010) is more common than (001) face.

The author is grateful to Prof. M. R. Srinivasa Rao, Department of Geology, Central College, Bangalore, for helpful suggestions.

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NOTE ON THE CEREBRAL GLANDS AND A HITHERTO UNKNOWN CONNECTIVE BODY IN JONESPELTIS SPLENDIDUS VERHOEFF (MYRIAPODA, DIPLOPODA)

THOUGH a large amount of work has been done on the neurosecretory system of various invertebrates^{1,2} only very little attention seems to have been paid to the group Myriapoda. The only reports appear to be those of Gabe^{3,4} and Palm⁵ on Chilopods and that of Gabe⁶ on diplopods, where besides the brain and the ventral nerve cord the cerebral glands are also reported to be concerned with neurosecretion.

The present study on the neurosecretory system of *Jonespeltis splendidus* Verhoeff, has revealed that, besides the cerebral glands, a pair of hitherto undescribed bodies, which are here termed the Connective bodies, are also concerned with neurosecretion. These are small oval structures measuring 65 μ in length and 45 μ in breadth on an average, and are attached to the circumoesophageal connectives

just above the postoral commissure (Fig. 1). These bodies appear distinctly pale bluish in colour in the live condition when examined under the stereoscopic binocular microscope.

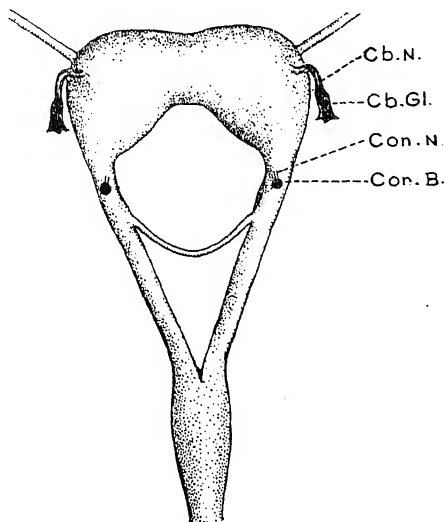


FIG. 1. Diagram of the nerve ring viewed from the dorsal side, showing its relation with cerebral glands and connective bodies, $\times 45$. *Cb. Gl.*, Cerebral Glands; *Cb. N.*, Nerves connecting the cerebral gland with cerebral ganglion; *Con. B.*, Connective Body; *Con. N.*, Connective Nerve.

They are filled with large masses of colloids stainable deep blue-black with Gomori's chrome-alum-haematoxylin-phloxine and Heidenhain's haematoxylin (Fig. 2). With Heiden-

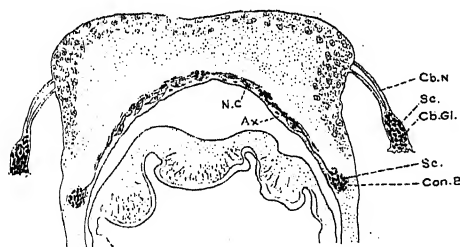


FIG. 2. Diagram showing the axonal transport of neurosecretory material from the tritocerebrum to the connective body, $\times 100$. *Ax.*, Axonic pathway from neurosecretory cell; *Cb. Gl.*, Cerebral Gland; *Cb. N.*, Nerves connecting the cerebral gland with the cerebral ganglion; *Con. B.*, Connective Body; *N.C.*, Neurosecretory cell on the mesial side of the tritocerebrum; *Sc.*, Secretory colloids.

hain's Azan the colloids are stained in different shades of red and blue. The cytoplasm of the connective bodies takes the phloxine of the Gomori's stain. The connective bodies are attached to the circumoesophageal connectives by means of a pair of small nerves. Careful

examination shows that the colloids come from the neurosecretory cells of the tritocerebral ganglia situated mesially, and are transported along the axons to the connective bodies in which they are stored up. The glands lie closely apposed to the ventral wall of a blood sinus lying behind the brain and it is likely that the product of neurosecretion is discharged into this sinus.

The cerebral glands are about 160μ in length and 100μ in breadth; their size and shape vary according to the amount of secretory product they contain. They are connected to the cerebral ganglia by two distinct nerves on each side. The glands contain large phloxinophilic colloids. Colloids could not be traced along the nerves. Gabe⁴⁻⁶ is of opinion that the cerebral glands also elaborate a secretion. It has not been possible to see this in *Jonespeltis* so far. These glands also lie close to the same blood sinus as do the connective bodies. They are attached to the sinus by digitate processes through which the secretory product seems to be voided into the sinus.

The presence of a sinus close to the cerebral glands as well as to the connective bodies suggests that the mechanism of release of neurosecretory products here is probably similar to that described in insects⁷ and crustaceans.⁸ Here the connective bodies as well as the cerebral glands are of the nature of storage and release centres and hence could be compared in the functional aspect, to the sinus glands of crustacea.

My thanks are due to the Government of India, for the award of a Research Scholarship, to Dr. K. Bhaskaran Nair for guidance, to Mr. V. Ananthanarayanan for facilities afforded, to Mr. R. Parameswaran for critical examination of the manuscript and to Dr. S. Jones for suggestions regarding identification of the specimen.

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INCIDENCE OF MARINE BORERS IN THE MANGROVES OF THE GODAVARI ESTUARY

WHILE it is well known that submerged wooden structures such as jetty pile, bottoms of boats, etc., in harbours are subject to attack by marine wood-borers, it is not so well known that their depredations extend to growing vegetation in tidal estuaries. The only previous report of a marine borer attacking mangrove is by Roonwal^{1,2} who described one species of a Teredinid, *Bactronophorus thoracites* (Gould) infesting mangrove vegetation in the Sundarbans, West Bengal. He further states that "similar mangrove forests in the Malay Peninsula do not appear to suffer in that way as far as one could judge from published accounts".

Recently we undertook a preliminary survey of the mangrove vegetation in the Godavari Estuary near Yanam to see if the trees are subject to marine borer attack. The mangroves occur not only in the swamps contiguous with the mainland but also in lowly raised islands, at some distance from the shores. The vegetation consists mainly of trees belonging to *Avicennia* sp. (locally known as *mada**) interspersed here and there with grass. At high-tide the roots and the stems of the trees are submerged up to a depth of about one foot. Examination of the dead stumps as well as the stems of living trees revealed that they were severely attacked by both Molluscan and Crustacean borers. The commonest Molluscan borer was *Teredo* (*Dactyloteredo*) *juttingae* Roch, while *Bankia* (*Bankiella*) *edmondsoni* Nair was also fairly common. *Bankia* (*Lilio-bankia*) *campanellata* Moll and Roch and *Teredo* (*Teredo*) *furcillatus* Miller were represented by a few individuals. Only three specimens of *Martesia striata* (Linn.) were encountered among the borers collected. A good number of the Crustacean borer *Sphaeroma terebrans* Bate were also present. Dead stumps were literally honeycombed with the teredinids. Living trees nearer the waters' edge which apparently looked healthy and green, were also severely attacked at the bases, 6 to 8" above and below the ground level. Obviously these would succumb during strong gales.

Our present investigation has shown that the destruction of mangroves by marine borers may actually be much more common and extensive than at present known. We have already encountered as many as five different species of Molluscan borers and a Crustacean borer in the present survey. Detailed investigations on

the systematics, ecology and distribution of these borers are in progress.

We are thankful to Dr. R. Nagabhushanam for help in identifying the Molluscan borers.

This work has been carried out with the funds provided by the Forest Research Institute, Dehra Dun, obtained from various sources for the execution of the scheme on "Protection of timber against marine organisms' attack".

Dept. of Zoology, P. N. GANAPATI,
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* A large number of local fishermen are dependent on this vegetation for their firewood.

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SOME OBSERVATIONS ON THE MONOGENETIC TREMATODES FROM THE GILL FILAMENTS OF SOME INDIAN FRESHWATER FISHES

INFECTION from dactylogyrid parasites (Trematoda: Monogenea) is very common among Indian freshwater fishes. Out of 517 specimens of fishes examined by the author during 1952-1957, 170 were found infected. The fishes examined belong to 37 species and 16 piscine families. The results of systematic investigation have been published elsewhere (Jain¹⁻⁵). In this note are recorded some observations on their feeding, locomotion and survival in artificial media. The only other study on locomotion is that of Mizelle,⁶ which is confined to North American forms. The fish selected for the present study was *Wallagonia attu* (Bloch.). It has been found to have an infection of 50% and harbours the following four species of parasites: *Haploclidus gomtius* (0.9-0.96 mm.), *Thaparocleidus wallagonius* (0.85-0.92 mm.), *Mizelleus indicus* (0.58-0.73 mm.) and *Sprostonia wallagonia* (0.55-0.72 mm.).

Dactylogyrids are known to feed on the blood contained in the thin capillaries of the branchial region. There is never an arrangement of cutting plates or any other puncturing apparatus in any form known. There is, however, a specialised apparatus, *haptor*, for adhering on to the tissues. Once the posterior attachment is secured the parasite has free anterior end to search for food. On examining live parasites in a drop of clean water, it was found that the pharynx was always protruded

(Fig. 1). It is probable that the parasites use the suction pump method in obtaining blood which passes out of thin membranous walls of the capillaries.

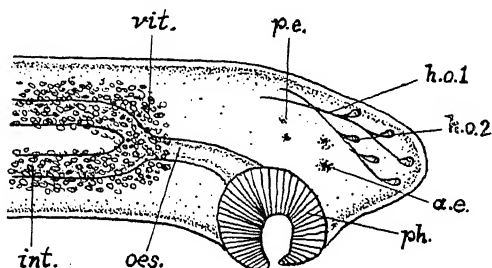


FIG. 1

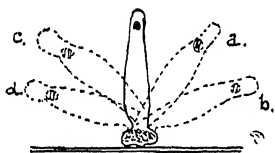


FIG. 2



FIG. 3



FIG. 4

FIG. 1. Diagrammatic sketch of a typical dactylogyrid, seen laterally with protruded pharynx, ventrally, a.e., anterior eye-spots, h.o. 1 and 2, head organs 1 and 2, int., intestine, oes., oesophagus, p.e., posterior eye-spots, ph., pharynx, vit., vitellaria.

FIG. 2. Diagrammatic sketch of a dactylogyrid 'smelling' for food.

FIGS. 3 and 4. Two methods of a dactylogyrid locomotion presented diagrammatically.

There is some sort of sense of selection of food source possessed by the parasites. The head organs (h.o. in Fig. 1) seem to be responsible for 'smelling'. Figure 2 shows a diagrammatic presentation of the 'smelling' behaviour of a parasite, the haptor attachment remaining fixed. The first position of the parasite is drawn in line while the subsequent positions, a, b, c, d, are drawn in dotted lines.

The parasites show two types of wriggling movements. First, the parasite adheres firmly by the haptor and then extends the body as far as possible, then fixes itself by pharynx

and releases the haptor to come near the anterior end. This process is repeated again. Second, the parasite attaches firmly by the haptor, extends the body and fixes the pharynx at a second point, then releases the haptor, body remaining attached to substratum by pharynx, and then attaches it to a third point. The two methods of progression are illustrated in Figs. 3 and 4.

No study seems to have been made before about the period of survival of dactylogyrids in artificial media. In the present study fishes from the morning catch (5 to 6 a.m.) were examined at about 10 a.m. It was surprising that even after 4 to 5 hours of the death of the fish, the parasites were largely found alive. The study of such microscopic parasites was only possible after their release from mucus which took another 5 to 7 minutes. It was observed that the parasites showed slow wriggling movements under a high power binocular microscope for another 10 to 15 minutes. For a more reliable estimate of survival, some parasites were taken afresh from small aquarium fish. *Mystus vittatus* (Bloch.) and examined. It was found that they showed wriggling movements for another 10 to 18 minutes. Thus it appears that the survival in clean freshwater is almost the same whether the fish has been dead for 4 to 5 hours or only 5 minutes.

The observations were made in the Zoology Department, Lucknow University. I am thankful to Professor M. B. Lal for the facilities in the present work.

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LIFE-HISTORY OF *APHIDIUS TESTACEIPES* (CRESSON) AND *PRAON AGUTI* (SMITH)—HYM. BRACONIDAE — PRIMARY PARASITES OF APHIDS, WITH NOTES ON THE EFFECTS OF PARASITISM ON HOSTS

THE braconids, *Aphidius testaceipes* (Cresson) and *Praon aguti* (Smith), parasitize many species of aphids. The life-history of *A. testaceipes* has been studied in detail by several workers.^{1,2,4,6,7} Reports on the life-history of *P. aguti* are lacking in the literature.

In the summer, 1954, on the campus of the University of Massachusetts, Amherst, Mass., U.S.A., the author observed a high degree of parasitism by *A. testaceipes* and *P. aguti* among several species of aphids. Along with other detailed studies, data on their life-histories and on the effects of parasitism on the host species were obtained. *Myzus persicae* Sulz. (Green peach aphid) for *A. testaceipes* and *Macrosiphum rosae* Linn. (Rose aphid) for *P. aguti* were selected as hosts.

The heavy pupal mortality in the last case (Table I) might be due to the susceptibility

nervous systems of the hosts were attacked and finally the muscular system was also consumed. However, the muscles of the host appendages were left intact, probably due to their inaccessibility to the parasite larva. Very soon the hosts became moribund. The sessile stage of hosts parasitized by *A. testaceipes* or *P. aguti* was reached several hours after their death. Before a host became sessile, the parasite larvae of both species were seen to make a number of revolutions within the host body. These revolutions were probably more concerned with the ingestion of the host body fluids by the para-

TABLE I
Life-history of *A. testaceipes* and *P. aguti*

Temp. °C.	Relative humidity %	Developmental period (in days) of 30 individuals					
		<i>A. testaceipes</i>			<i>P. aguti</i>		
		Egg	Larva	Pupa	Egg	Larva	Pupa
27.6	86	15			15		
29.0	86-68	4			4		
32.0	72	Normal			Normal		
		Failed (56.6% of total pupae lost)			Failed (70.0% of total pupae lost)		

of the pupal stage of the two species to those physical conditions which the egg and larval stages could withstand better due to the presence of host body fluids surrounding them. The higher percentage loss of the pupae of *P. aguti* could probably be due to a still greater degree of exposure to the conditions since, this species, as opposed to *A. testaceipes*, passes the pupal stage outside the dead host or due to the difference in the degree of susceptibility of each parasite species.

EFFECTS OF PARASITISM ON HOSTS

Aphids struck by either parasite species showed a to-and-fro motion lasting for some time. Renewed attacks produced a marked degree of sluggishness on the hosts and apparently stimulated them to eject copious quantities of exudate through the cornicles. New-born aphids often succumbed to multiple attacks. Hosts parasitized before they had reached the third instar died prior to maturity. Successful parasitism on hosts that had reached the reproductive stage effected a cessation in their reproduction when the parasite larva reached the third stage and these hosts subsequently stopped feeding. As the parasite larva reached the fourth stage, the digestive and

site larva than to make the host body spacious for the pupal stage of the parasite.⁶

It is recorded⁶ that as soon as the larva of *A. testaceipes* was full grown, the aphid abdomen turned yellow becoming more intense and conspicuous as the host reached the sessile stage. In the present studies, the colour of the parasitized aphids was found to vary with the parasite species, and also in the case of a parasite species, the sessile host colouration varied even within a host species depending upon the food plant of the latter. Thus, the cotton aphid, *Aphis gossypii* Glov., remaining sessile on *Hibiscus* due to parasitization by *A. testaceipes* was much darker than that on squash (*Cucurbita* sp.). Similarly, the rose aphid becoming sessile on rose due to parasitization by *P. aguti* was pearly white in colour. However, the same aphid species becoming sessile on a brown leaf surface was often found rather pale brown in colour, indicating that the colour of the surface also—not necessarily a plant host media—conditioned the sessile stage colouration.

The many valuable suggestions and criticisms offered by Dr. Harvey L. Sweetman, Depart-

ment of Entomology, University of Massachusetts, Amherst, Mass., U.S.A., during the conduct of the above studies, are very much appreciated.

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STAGE OF DEOXYRIBONUCLEIC ACID SYNTHESIS DURING MITOSIS AND MEIOSIS

It is now well established that of all the chemical constituents of the nucleus so far analysed, the deoxyribonucleic acid (DNA) content is quantitatively the most predictable and consistent. The constancy of its content in nuclei of various plant and animal tissues has its parallel in the constancy of the chromosome number of these cells, and the genetic significance of DNA is hence evident.¹ Data from microspectrophotometric and autoradiographic studies in normal and irradiated plant and animal cells indicate that DNA synthesis and chromosome doubling are synchronous events thereby strengthening the view that an intimate relation exists between chromosome duplication and synthesis of DNA. While the importance of DNA as genetic material is no longer in doubt, there is still some controversy regarding the exact stage and time when DNA duplication takes place during cell division in somatic and gametic cells. Thus, Pasteels and Lison² found that DNA synthesis occurs during anaphase and early telophase of mitosis while Alfert and Swift³ found it to occur during interphase. Similarly, while Swift⁴ observed that in microsporocytes of *Tradescantia* DNA synthesis takes place during leptotene, Sparrow *et al.*⁵ reported from studies in *Trillium* that DNA content increases till late pachytene or diplotene. On the other hand, in studies in *Lilium* involving the detection of P³² incorporation into the DNA fraction of chromosomes by the autoradiographic method, Taylor and McMaster⁶ found that DNA synthesis occurs during pre-

leptotene, i.e., that part of pre-meiotic interphase which immediately precedes leptotene.

Improvements in cytophotometric techniques such as the use of the two wavelength method introduced by Patau⁷ and Ornstein⁸ have rendered accurate estimations of DNA content of individual nuclei possible. Using a microspectrophotometer constructed on the two wavelength principle,⁹ we studied the DNA content of individual cells during various stages of mitosis and meiosis in *Secale cereale* ($2n = 14$). The results of this study are summarised in Tables I and II (DNA content is expressed in arbitrary units).

From Table I, it will be seen that the DNA value at the resting stage during mitosis was 4.75 ± 0.055 . This amount can be referred to

TABLE I

DNA content at various stages of cell division
in the root tips of *Secale cereale*

Stage	No. of measurements	Range	Mean DNA content \pm S.E.
Resting ..	17	4.09- 5.13	4.75 ± 0.055
Interphase ..	24	4.68- 9.98	8.22 ± 0.369
Prophase ..	19	8.78-10.23	9.65 ± 0.086
Metaphase ..	16	8.65-10.35	9.56 ± 0.108
Anaphase ..	10	8.99-10.20	9.56 ± 0.123
Telophase ..	10	9.16-10.12	9.67 ± 0.107

as the 2c content corresponding to the 2n number of chromosomes. The DNA content increased during interphase and values ranging from 2c to 4c were observed, thus suggesting that DNA synthesis was in progress during this stage. At metaphase, anaphase and telophase, the DNA content remained at the 4c level. The data hence lend further support to the findings recorded earlier by Seshachar,¹⁰ Patau and Swift,¹¹ Pelc and Howard¹² and many others that during mitosis DNA synthesis is initiated and completed during interphase.

The meiotic observations can be grouped into 4 classes (Table II). First, the lowest value

TABLE II

Relative DNA content during microsporogenesis
in *Secale cereale*

Stage	No. of measurements	Range	Mean DNA content \pm S.E.
Pre-meiotic ..	10	3.95- 4.93	4.72 ± 0.053
Leptotene ..	19	7.65-10.13	9.23 ± 0.168
Zygotene ..	10	9.23- 9.97	9.47 ± 0.083
Pachytene ..	10	9.36- 9.99	9.60 ± 0.080
Diplotene ..	10	9.13-10.07	9.47 ± 0.090
Diakinesis ..	10	9.34-10.13	9.57 ± 0.099
Microspore ..	15	2.28- 3.13	2.50 ± 0.060

corresponding to 1c content occurred in the microspores. Secondly, the nuclei of cells at pre-meiotic interphase had a DNA content equivalent to the 2c content. Thirdly, the greatest variability in DNA content ranging from 3c to 4c content was observed during leptotene. Fourthly, the DNA value remained constant at the 4c level during zygotene, pachytene, diplotene and diakinesis. From the data, it seems likely that DNA synthesis takes place during leptotene. However, we did not observe typical 2c amounts of DNA in the cells at leptotene studied by us. We had chosen clear leptotene cells for the study and since these had a minimum of 3c DNA content, it is likely that DNA synthesis had started at a stage slightly earlier to leptotene. The finding of Taylor and McMaster⁶ that DNA synthesis is initiated during pre-leptotene hence appears to be correct. However, the process of DNA duplication is not completed during pre-leptotene as concluded by these authors but continues during leptotene and ends only before the onset of zygotene. Thus, our data support in part the findings of both Swift⁴ and Taylor and McMaster.⁶ Mitra¹³ has recently presented data showing that in cells of *Lilium longiflorum* irradiated at the pre-meiotic stages prior to pre-leptotene only chromosome type of aberrations were obtained. They persisted in cells treated up to early leptotene but disappeared before the beginning of zygotene. Chromatid breaks, on the other hand, appeared abruptly about mid-pre-leptotene and persisted until diakinesis. From this and our data it seems reasonable to conclude that during meiosis, DNA synthesis (and consequently chromosome duplication) is initiated during pre-leptotene and completed during leptotene.

We are grateful to Dr. B. P. Pal and Dr. A. B. Joshi for their interest in this study. We are deeply indebted to Dr. D. Sen of the Optics Division, National Physical Laboratory, New Delhi, for his help in setting up the microspectrophotometer.

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IRON-COPPER ANTAGONISM AND GROWTH OF *PIRICULARIA ORYZAE*

THE essentiality of heavy metals, iron, zinc, manganese and to a certain extent copper, for the growth of *Piricularia oryzae* Cav. has been reported.¹ During the course of further investigations,² a close scrutiny of the deficiency yields of the fungus revealed antagonism, additive effects and interaction among these

TABLE I

Treatments		Mat weight in mg.
1	-all (Purified medium) ..	11
2	+Cu ..	1
3	+Zn ..	7
4	+Zn Cu ..	0
5	+Fe Cu ..	6
6	+all (Fe Zn Cu Mn) ..	153

ions (Table I). The most noticeable toxic effect was that of Cu and to a lesser extent that of Zn on growth and was apparent only in the absence of other essential elements, but if Fe and Mn were also present the toxic effect of Cu and Zn tended to be counteracted. These effects were, however, noticed in heavy metal deficient media where growth was too little to permit definite conclusions. This ionic toxicity of Cu and the interaction of other heavy metals in counteracting the same were, therefore, studied with induced toxicity in an otherwise complete medium by supplying 110 µg. of Cu (per flask of 20 ml. medium) and the Cu toxicity counteracted with the same amounts of Fe, Zn and Mn singly and in all possible combinations when the elements other than those under consideration were always present in optimal doses. It must be emphasized here that these three elements were not toxic to growth at 110 µg./flask.² The various treatments and the results obtained are recorded in Table II.

Table II shows that '+Cu' (110 µg.) was toxic even in the presence of other elements in optimal amounts though slight growth took

TABLE II

Treatments	Concentration of trace elements $\mu\text{g./flask}^*$				Mat weight in mg.
	Fe	Zn	Mn	Cu	
1 +all	.. N	N	N	N	153
2 +Cu	.. N	N	N	110	0
3 +Cu Fe	.. 110	N	N	110	137
4 +Cu Zn	.. N	110	N	110	0
5 +Cu Mn	.. N	N	110	110	14
6 +Cu Fe Zn	.. 110	110	N	110	45
7 +Cu Fe Mn	.. 110	N	110	110	49
8 +Cu Zn Mn	.. N	110	110	110	39
9 +Cu Fe Zn Mn	.. 110	110	110	110	45

* 'N' denotes optimum level of the metal.

place which could not be assessed quantitatively. If Zn was added to Cu practically no growth occurred indicating the additive effect of Zn on copper toxicity. The addition of 110 $\mu\text{g.}$ of Fe, however, counteracted copper toxicity resulting in almost normal growth of the fungus. Manganese, on the other hand, could not reverse copper toxicity to any appreciable degree. All the two-element (Fe Zn; Fe Mn; Zn Mn) and three-element (Fe Zn Mn) combinations (each element added at the rate of 110 $\mu\text{g./flask}$) supported only a moderate growth of the fungus indicating that the beneficial effect of iron in counteracting copper toxicity is lessened in the presence of Zn and/or Mn. It is thus clear that Fe and, to a much less extent, Mn effectively antagonize copper toxicity. Zinc, on the other hand, appears to exert an additive effect. The presence of Zn or Mn or both reduces the efficacy of iron-copper antagonism indicating the interaction among various elements.

The phenomenon of ion-antagonism in the nutrition of fungi has been shown to exist by many workers.³⁻⁵ However, a definite antagonism between Cu and Fe affecting growth of fungi does not seem to have been reported although this has been noticed in penicillin production by *Penicillium chrysogenum*.⁶ The mechanism of Fe-Cu antagonism shown in the present studies remains to be investigated. It is probably very similar to that encountered between Cu and other elements. Discussing the mechanism of toxic action of metal cations on fungi, Horsfall⁷ observes that they primarily act at or very near the surface of the cell by replacing the non-toxic cations from the anionic surface sites on the cell wall. It could then be assumed that Fe may act competitively with Cu for the anionic sites on the cell thus reducing the uptake of Cu. That the uptake of Cu

by spores of *Monilia fruticola* is depressed in the presence of certain other metallic elements—magnesium, potassium and calcium—has been reported by Marsh.⁸

I am indebted to Professor T. S. Sadasivan, Director, University Botany Laboratory, Madras, for guidance and to Dr. C. V. Subramanian for helpful suggestions.

University Botany Laboratory, A. APPARAO.
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A NOTE ON SOME SOUTH INDIAN SPECIES OF THE GENUS *DIOSCOREA*

The genus *Dioscorea* is fairly well represented in South India growing luxuriantly, especially, in the States of Kerala and Madras. It has always served as a famine food to the tribal peoples. A few species as *D. hispida* are inedible but even these can be rendered edible by observing proper precautions. In the Central Botanical Laboratory a cyto-taxonomic survey of the genus is under progress.

Out of the 16 species reported by Gamble in his *Flora of the Presidency of Madras*, 7 species have already been collected and worked out cytologically by the author.¹ In the present paper two more species, namely, *D. wallichii* and *D. tomentosa* besides another variety, of *D. pentaphylla* not reported previously, have been worked out for the first time.

D. wallichii Hook.f. collected from the hills surrounding Coimbatore is found growing wild. It is a climber twining to the right with the tubers very long and lying deeply buried. It is known in Malayalam as Varakilangu and is edible. The somatic number of the plant examined was found to be $2n = 40$.

D. tomentosa Koenig. is a climber twining to the left and is a very common species occurring wildly in South India. It has been collected from Coimbatore and Annamalai Hills and is known by a variety of vernacular names as Noolkilangu, Noolvallikilangu, and Chavalkilangu, the names denoting the fibrous

nature of the tubers. Though edible the tribals do not very much value it as an article of food because of the fibres traversing the fleshy portion. The tubers are several, cylindrical, very long and branched, the length of them exceeding a metre and a half. Cytological examination revealed the existence of at least two races with $2n=40$ and $2n=60$ chromosomes.

During the course of the present study a large number of plants belonging to *D. pentaphylla* was examined. The tubers of *D. pentaphylla* L. var. *communis* Pr. & Burk. can be readily distinguished from vars. *linnæi* and *jacquemontii* in that the tubers of var. *communis* are short and not elongated to more than twice the diameter. As an article of food var. *linnæi* is always preferred to var. *communis*; in fact the tubers of the latter are invariably avoided because of their nauseous and fibrous nature. Cytological studies of all the tubers revealed the existence of only two races in *D. pentaphylla*. The $2n=40$ form was confined to var. *linnæi* and *jacquemontii* while var. *communis* always showed $2n=80$ in somatic counts. Interestingly enough, none of the Indian forms examined so far has revealed $2n=144$ chromosomes as recorded by Smith² for the same Asiatic species.

Besides the above species many plants belonging to the *D. oppositifolia* and *D. hispida* were also collected and studied. Both the species showed only $2n=40$ chromosomes which is the same as reported by the author in an earlier paper.

Prain and Burkill³ have recorded that bulbils are never formed in *D. hispida*, *D. wallichii*, *D. tomentosa* and *D. oppositifolia*. The present observations agree with Burkill's findings; however, in *D. hispida* collected from Annamalai and grown at Allahabad, a few bulbils were formed though they were not very well developed.

This survey of South Indian species of *Dioscorea* which is the first to be reported reveals that polyploidy exists in 5 of the species examined so far. The chromosome numbers are summarised as follows:

<i>D. alata</i> L.	$2n=40, 60$ and 80 .
<i>D. esculenta</i> Burkill	$2n=90$ and 100 .
<i>D. bulbifera</i> L.	$2n=40, 80$ and 100 .
<i>D. pentaphylla</i> L.	$2n=40$ and 80 .
<i>D. tomentosa</i> Koenig.	$2n=40$ and 60 .

Sharma and De⁴ have worked in some detail two North Indian species of cultivated *Dioscorea* namely, *D. alata* and *D. sativa*, but it is seen

that the South Indian forms have different polyploid races besides those recorded by them. In four species as *D. hispida* Dennst., *D. oppositifolia* L., *D. pubera* Bl. and *D. wallichii* Hook.f. the diploid number has been found to be $2n=40$ only. In the case of *D. belophylla* Voigt. collected by Shri K. S. Srinivasan, Curator, Industrial Section, Indian Museum, Calcutta, the diploid number has been found to be $2n=80$.

The author is indebted to Dr. K. Subramanyam, Regional Botanist, Southern Circle, Botanical Survey of India, for the facilities afforded in the collection of wild species of *Dioscorea* at Coimbatore and to Dr. S. K. Mukherjee, Keeper, Central National Herbarium, for identification of the herbarium sheets. Central Bot. Lab., R. SUNDARA RAGHAVAN, Allahabad, May 18, 1959.

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PLEUROPNEUMONIA-LIKE ORGANISMS FROM POULTRY IN INDIA

NOCARD and his associates in 1898 studied Pleuropneumonia-like organisms (PPLO) and considered them to be the causative agent of bovine pleuropneumonia. Dienes and Edsall in 1937 recovered PPLO from a suppurating human Bartholin's gland. Since then a number of reports on the isolation of PPLO, either parasitic or saprophytic, mostly from humans, have often appeared.

After Markham and Wong (1952) isolated PPLO from exudates of chickens and turkeys with chronic-respiratory disease (CRD) and indicated that these could be cultivated in cell-free medium, several workers, mostly American, have reported about the occurrence of the avian PPLO.

In India, although there have been indications of the presence of the CRD for some time past, Rao (1958) could not establish the presence of the PPLO in his studies on infectious coryza in chickens.

During the routine post-mortem examination of poultry submitted to this department for the last few years it has been observed that quite a few birds show lesions similar to that

of the so-called CRD. However, the isolation and identification of the PPLO could not be made earlier. Recently attempts made on the lines suggested by Taylor and Fabricant (1957) to isolate PPLO from air-sacs, lungs and trachea of the birds showing such lesions, proved successful.

From tracheal swabs collected from 202 birds, it was possible to isolate PPLO from 188 birds. The biochemical characters studied revealed that the majority of the strains produced acid in glucose and maltose and some in sucrose also. Gas was never produced. Cultures were also made on 20% horse serum agar and the colony characteristics were studied after staining them by the method of Dienes (Adler *et al.*, 1958) (Fig. 1).

Similar studies made on 30 birds of White Leghorn and Rhode Island Red breed on the

The authors are indebted to Sri. P. G. Pande, Director, Indian Veterinary Research Institute, Izatnagar, and Dr. G. I. Wallace, Professor of Bacteriology, University of Illinois, U.S.A., for valuable suggestions, to Dr. S. C. Ray, Milk Commissioner, Government of West Bengal, for his kind permission and facilities provided at the Heringhata Farm, Calcutta, and to Sri. C. V. G. Choudary, Principal, U. P. College of Veterinary Science and Animal Husbandry, Mathura, for providing facilities for the work.

Dept. of Path. & Bact.,
U. P. College of Vet. Sci.,
and Animal Husbandry,
Mathura, February 23, 1959.

R. C. PATHAK.
C. M. SINGH.

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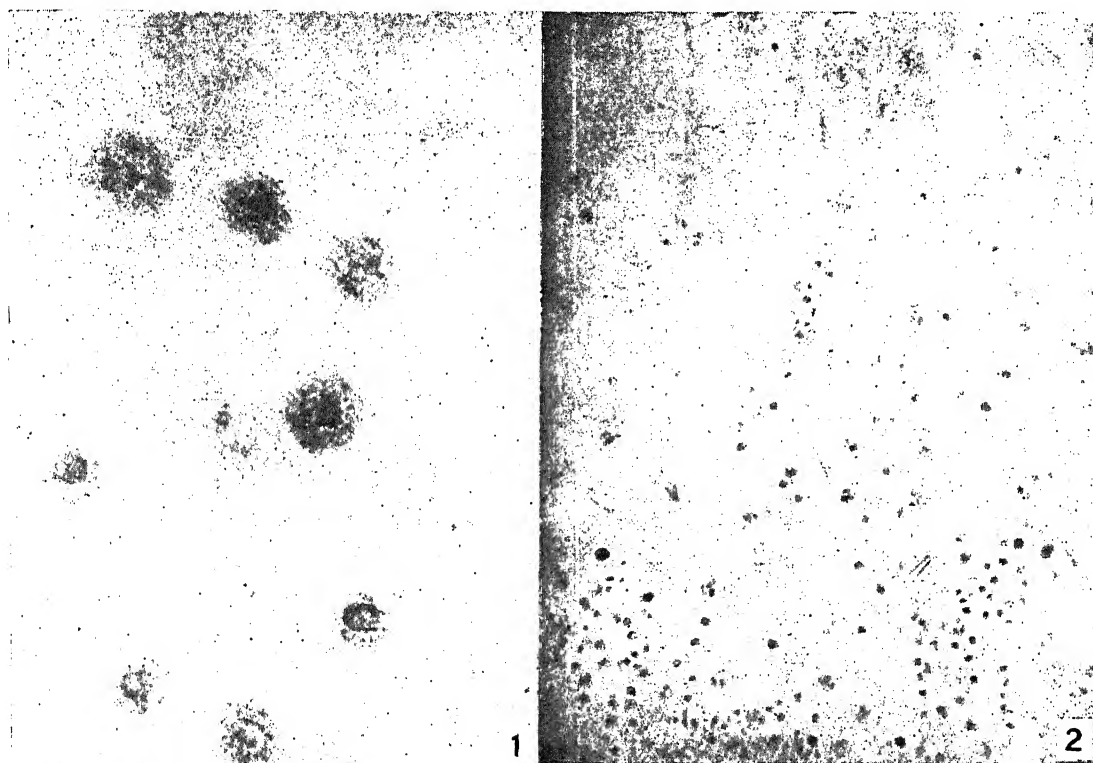


FIG. 1. Two types of colonies of avian pleuropneumonia-like organisms. The colonies on the right are slow growing types after 96 hours of incubation at 37.5°C on serum agar plates. The colonies on the left are rapidly growing types under similar conditions, $\times 120$.

poultry maintained at Heringhata Farm, Calcutta, revealed the presence of PPLO in 17 birds.

The results presented here are the first reported instance of the isolation of PPLO from poultry in India. Further work is in progress.

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DISTRIBUTION OF *PERISTROPHE BICALYCOLATA* NEES. IN RELATION TO SOIL NITROGEN AND LIGHT

MISRA^{1,2} reported the occurrence of *Peristrophe bicalyculata* Nees. on nitrogen poor soil in the open, and nitrogen rich soil in the shade, and could not reconcile how light compensated for soil nitrogen deficiency in the open for this plant. An estimation of soil nitrate and total plant nitrogen, from collections in light and shade as given in Table I, now reveals that in every locality examined the shade plants are richer in nitrogen. It, therefore, indicates a high nitrogen requirement and utilization by the plant in shade. This observation formed the basis for further experimentation by pot culture and is reported here.

TABLE I

Locality	Nitrate nitrogen in soil (mg./100 g. of soil)		Total nitrogen in plant % (Dry wt. basis)	
	Open	Shade	Open	Shade
Latifshaw ..	2.60	3.40	2.80	3.24
Rajghat ..	2.20	3.00	2.60	3.08
Sarnath ..	2.80	3.80	2.94	4.83
University area ..	2.48	3.75	3.00	3.71
Ramnagar ..	2.75	6.13	3.01	4.91
Akhari ..	2.10	4.10	2.48	3.87

Three sets of five pots were prepared with unmanured garden soil. Set A pots were placed

nated in each pot. After noting the percentage germination of the seeds, two thrifty and identical seedlings were planted in each case to observe their growth behaviour, and finally the crop in each was harvested after three months' growth, for determination of total plant nitrogen. The data are set in Table II.

There appears to be a reaction between light intensity and soil nitrate as percentage germination increases with higher nitrate in decreased light, whereas nitrate retards germination in high light intensities. Good growth is seen under partial shade especially with higher doses of nitrate. Fully shaded plants show considerably poor growth but there was enhanced assimilation of nitrogen.

The natural distribution of the plant in nitrogen poor soil in the open is, therefore, explainable primarily on account of favourable germination of seeds and subsequent normal growth. However, it seems obvious that the most suitable habitat of the plant is a nitrogen-rich soil under partial shade. It is further seen that the percentage germination is much higher on nitrogen-rich soil in full shade but further growth of the seedling appears negligible presumably on account of deranged nitrogen metabolism. A detailed account of the work will appear elsewhere.

Department of Botany, R. MISRA.

Banaras Hindu Univ. P. S. RAMAKRISHNAN.
Varanasi-5, April 2, 1959.

TABLE II

Monthly dosage of ammonium nitrate (g.) added to soil	Set A — Open			Set B — Partial shade			Set C — Full shade		
	% germination	% total N ₂ in plant	Growth performance	% germination	% total N ₂ in plant	Growth performance	% germination	% total N ₂ in plant	Growth performance
0.0	16	2.38	Plants taller, less branched, no flowers and fruits	0	2.33	Poor growth, no flowers and fruits	0	2.87	Poor growth, no flowers and fruits with very few leaves
0.2	16	2.24		16	2.73	Good growth, no flowers and fruits	16	4.27	
0.4	0	2.24	Plants bushy with no flowers and fruits	12	2.75	Best growth, flowering and fruiting	20	4.55	
0.6	0	2.17		8	2.80	Good growth, no flowers and fruits	20	4.55	
0.8	0	1.96		4	2.94	Poor growth, no flowers and fruits	40	4.60	

in the open, set B in partial shade and set C in full shade. To four of the pots in each set, were added 0.2, 0.4, 0.6 and 0.8 g. of ammonium nitrate each month, and 100 seeds collected from a uniform population of the species were germi-

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REVIEWS

Physics of Meteor Flight in the Atmosphere.

By Ernst J. Opik. (*Interscience Tracts on Physics and Astronomy*, No. 6; Interscience Publishers, Inc., New York 1), 1958. Pp. viii + 174. Price: Paper Bound \$ 1.95; Hard Bound \$ 3.85.

This booklet is mainly a theoretical tract dealing with the many problems associated with the flight of meteors through the upper atmosphere of the earth. The physical approach to the problems consists in predicting the variation of mass, velocity, luminosity, and ionization along the meteor trajectory.

The major part of the book is devoted to collisions, energy transfer, ablation and meteor radiation. The radiation and ablation of meteors take place in proper altitudes prescribed by a kind of 'natural selection' depending on size and velocity.

For the purpose of treating the processes occurring in collisions, meteors are divided into two classes, (i) when the free path of the air molecules is smaller than the linear dimension of the meteor, in which case the collision is preceded by the formation of a hydrodynamic cushion, or air-cap, in front of the meteor, thus impeding the heat transfer, and (ii) when the free path is greater than the radius of the meteor, in which case no air-cap is formed and the impact momentum and energy are transmitted to the nucleus of the meteor by direct hits of the air molecules.

Meteor sizes vary from $\cdot 03$ to 10 cm. The velocity range of visible meteors is between 20 and 70 km./sec. Micrometeors with radii often between 10^{-3} and 10^{-4} cm. offer a special problem. They are too small to be observed with optical means but, are however, rendered "observable" by their direct impact on receivers sent up in rockets. They form the bulk of the zodiacal-light cloud and their mass per volume of space greatly exceeds that of all other meteors taken together. Entering the atmosphere at a low speed of 12 km./sec. which is only slightly in excess of the escape velocity 11.2 km./sec., they undergo very little evaporation, and are eventually collected from the deep-sea clay as the well-known cosmic spherules.

The author who is well known for his special studies and contributions in meteor theory has encompassed in this little tract a good deal

of theoretical as well as practical information which will provide a basis and a background for further research in the physics of meteors.

A. S. G.

Scientific Uses of Earth Satellites. Edited by James A. Van Allen. (The University of Michigan Press, Ann Arbor), 1956. Pp. x + 316. Price \$ 10.00.

This volume is a compilation of 33 papers presented by leading scientists in the field of planetary physics, at a meeting of the Upper Atmosphere Rocket Research Panel (U.S.A.) in 1956. These describe the advances that have been so far made and the possible contributions artificial satellites can make to our knowledge of the Universe.

The authors in their respective papers have described the nature of the experiments that are likely to be conducted in the particular field.

The usefulness of an earth satellite in studying the meteorology of the earth is reviewed. A single geiger tube or scintillator carried in the satellite will make possible the study of the cosmic intensity above the atmosphere. The possibilities of exploring the atmosphere with a satellite-borne magnetometer and measurement of earth's magnetic field from a satellite vehicle are discussed in detail. A method for measuring the influx of meteoric particles into earth's atmosphere, based on the detection of the acoustical energy generated upon impacts, is described.

The volume under review presents current thinking of leading scientific experts on satellites and describes rapid advances that were made in the science of artificial earth satellites.

S. B.

Electroanalytical Chemistry. By James J. Lingane. Second Edition. (Interscience Publishers, Inc., New York 1), 1958. Pp. xiv + 669. Price \$ 14.50.

The first edition of this book was published in 1953. During the five years the applications of electroanalytical technique have expanded in its different aspects and to cope with this expansion the present edition has been revised and considerably enlarged. The new chapters added are (i) Chapter II on electrical measure-

ments which, though of an elementary nature, makes the book self-sufficient by providing the necessary background for the understanding, by beginners, of the specialised instruments described in individual chapters; (ii) Chapter XI on polarographic analysis which was omitted in the first edition for the obvious reason that the author himself, along with I. M. Kolthoff has written a standard and exhaustive monograph on this most fruitful branch of electroanalytical chemistry. In this chapter the essential principles of polarographic analysis are given leaving the details to references in the bibliography. (iii) Chapter XII on amperometric titrations and (iv) Chapter XXII on chrono-potentiometry which discusses the technique of obtaining and using the potential-time curve for analytical purposes.

The subject of coulometric titration has been dealt with, in the present edition, in two separate chapters, one on instruments and technique, and the other on its many applications. Coulometric titration has two main advantages, *viz.*, that it can more easily be automatised than the ordinary volumetric titration, and that it eliminates the need for standard titrant solutions.

Standard potentials of important half-reactions of the elements and their compounds which are very often needed in electroanalytical processes are given in the 13 pages of the Appendix.

This revised and enlarged edition makes the book a comprehensive monograph on the subject and there is no doubt that it will be of great use to graduate students and those who are to be initiated in the special branch of electro-analytical chemistry. The printing and get-up of the book are of the high standard characteristic of Interscience Publications.

A. S. G.

Radioisotopes in the Service of Man. By Fernand Lot. (UNESCO, Place de Fontenoy, Paris-7), 1959. Pp. 82. Price \$ 1.00.

The applications of artificial radioactive elements are becoming increasingly wider and often spectacular and the present time may be truly called the era of radioisotopes. In this little book under review which forms the sixteenth in the series of information pamphlets issued by the UNESCO, up-to-date information is given on the various aspects of radioisotopes in the service of man. It traces the discovery of natural and artificial radioactivity, the production of radioactive isotopes and the methods of detecting the radiations given off by them. Then follow chapters on applications of radio-

isotopes in medicine, industry, science and technology; their use in the improvement of soils, plants and animals and in technical developments, as for example, in metallurgy and petroleum industry.

The discovery of radio cobalt (Co 60) and the comparatively easy method of producing it in atomic piles, has made radiotherapy not a luxury treatment but available at reasonable cost to all who need it. The new technique in the control of radiation from radiocobalt in what is come to be known as the cobalt "bomb" has enabled its use as a source for gamma radiation at a distance, and the cobalt teletherapy apparatus for treatment of various types of tumours is finding increasing use and has become almost a routine equipment in anti-cancer clinics.

The pamphlet is written in simple language is profusely illustrated and provides informative reading.

Metabolic Factors in Cardiac Contractility.

By F. N. Furness, M. Selzer and M. M. Gertler, Editors. (New York Academy of Sciences), 1959. Pp. 171. \$ 3.75.

This volume which contains a series of papers presented at a conference held on March 18 and 19, 1958, is another tribute to the policy of the New York Academy of Sciences in selecting controversial subjects for their symposia.

The papers are selected on the working hypothesis that "one of the principal and final causes of congestive heart failure is in essence a failure of the available chemical energy to be transformed and utilized as mechanical energy by the heart". This energy is required not only for maintaining the muscular activity of the heart but also for maintenance of intracellular volume since in heart diseases we find that the tissues cannot keep out water and become swollen. The bulk of the papers in this volume, therefore, deals with oxidative phosphorylation associated with carbohydrate metabolism and the physiological effect of ions in regulating cell volume. There is also one paper on the concentration of ions other than sodium and potassium in heart diseases. The papers are presented by clinicians, physiologists, biochemists, biophysicists and physicists so that persons of one discipline can gain from the knowledge of others.

The controversial nature of the problem of the role of energy in the normal working of the heart can be realised from a recent paper (*Nature*, 1959, 183, 997) where it has been shown

that swelling of mitochondria takes place under conditions favourable to oxidative phosphorylation. The authors have, therefore, not drawn any definite conclusions about the actual reasons for congenital heart failure. Nevertheless, a wealth of information has been presented on different aspects of the problem by masters in the field like E. Racker, M. F. Utter, S. Grisolia, T. P. Singer, G. W. E. Plaut, R. J. Podolsky and others. This volume is an important contribution to our knowledge of cardiac contractility.

T. RAMAKRISHNA.

British Medical Bulletin—Haematology, Vol. 15, No. 1. (Published by the Medical Department. The British Council, London, W. 1; India: Oxford University Press), 1959. Pp. 83. Price 20 sh.

The application of the newer techniques of chromatography, electrophoresis, immunochemistry, tissue culture and radio isotopes, in elucidating the many, still unsolved problems of hæmatology, has yielded interesting results.

Some aspects of these studies, in this Bulletin, particularly those pertaining to the metabolic studies of the hæmatics, Iron, Folic acid and Vitamin B₁₂; Biosynthesis, chemistry and inheritance of human hæmoglobins; origin and life-history of the cellular constituents of the blood and bone marrow and the hæmatology pathogenesis and treatment of hæmolytic syndromes are highly informative.

The new concept of 'molecular disease' as applicable to hæmoglobinopathies and the chemistry of abnormal hæmoglobins has given valuable insight into the action of genes and the fine control exercised by them. The lucid presentation of this theme has definitely enhanced the value of this volume to all research workers engaged in the study of the pathogenesis of diseases in general and blood dyscrasias in particular.

M. SIRSI.

Endocrine Control in Crustaceans. (Cambridge Monographs in Experimental Biology. No. 10.) By D. B. Carlisle and Sir Francis Knowles. (Cambridge University Press, London.) Pp. 120. Price 21 sh.

Although the terms 'internal secretions' and 'chemical messengers' had been introduced to physiology in the XIX century by Claude Bernard, and Brown-Sequard and d'Arsonval respectively, the concept of a chemical co-ordination of functions in the animal body was developed much later (1904) by Bayliss and

Starling, in whose laboratory the name 'hormone' was invented, and the first recognisable hormone, *secretin*, was discovered. Ever since, the study of vertebrate hormones has made phenomenal progress, but there was no clear proof of the existence of a hormone in invertebrates until 1928, when Koller showed that the contraction of the chromatophores of the shrimp is caused by a substance in its eye stalk. Thus, invertebrate endocrinology, in particular crustacean endocrinology, started.

The book under review is an authoritative and accurate account of the progress of crustacean endocrinology during the last thirty years, written by authors, who themselves have made very significant contributions to the development of the subject.

Crustacean endocrinology, as described in this book, shows three phases of development. During the first phase (1929-39), the presence of chromactivating hormones was demonstrated and the sinus gland was suggested as the source of these substances. During the second phase (1939-50) it was shown that there were several distinct chromactivating substances and that various aspects of metabolism, growth and development were under hormonal control. It was during this phase that suspicion also arose that the sources of hormones were within the nervous system. During the third phase of crustacean endocrinology (1951—) it has been shown that the endocrine systems in Crustacea are neurosecretory, and that the hormones are produced in modified neurones and transferred along the axons to the sites of release into the blood.

What about the future lines of investigation? The unravelling of the structure of the neurosecretory cells under the electron microscope and the biochemistry of their hormones will be the main lines. These lines have been already started, and it has been shown that the chromactivating hormones are peptide in nature, whereas the ovary-inhibiting hormone is a steroidal substance. Then there are also the lower crustacea to be investigated. Further progress in crustacean endocrinology may be expected to throw some light on the significance of neurosecreting mechanisms in the animal kingdom and also on the comparative evolution of the nervous and chemical co-ordinating mechanisms.

The book is written with scientific insight and includes over 250 original references. It will be useful not only to students of crustacean endocrinology but to all interested in a physiological approach in biology.

The format of the book is good, and the illustrations, which are clear and instructive, add to the scientific value of the book.

R. V. SESHAIYA.

Mechanical Cultivation in India. By Dr. D. A. Gadkary. (The Manager, Publications, Civil Lines, Delhi), 1957. Pp. vii + 147. Price Rs. 7.25.

This is a monograph published by the Indian Council of Agricultural Research with a Foreword by the Minister of Food & Agriculture and a Preface by the Vice-President of the Council. The book contains all the information collected from various States on subjects, like the scope for mechanical cultivation in the country, farm machinery and its use in different areas, maintenance of machinery and organisational problems. The subject-matter is divided into four chapters with an extensive set of appendices and a short bibliography.

Mechanisation in its wide sense is usually taken to include not only power-driven equipment like tractors, but also improved agricultural implements worked by hand and bullock power. The present publication, however, deals only with the former. Mechanisation for particular types of work is now accepted as an essential element in increasing crop production in the country. It is also accepted that mechanical cultivation would be feasible only if farmers group themselves into co-operative societies and have a central pool of machines for cultivation.

The limitations and the scope for mechanical cultivation is sufficiently explained in Chapter I. Some idea has also been given of the minimum acreage that would be required for the economic employment of tractors. There is enough evidence to show that conducting agricultural operations with power-driven machines has by itself no advantage in respect of yield though it does give a better tillage and more uniform depth of ploughing. The main feature, however, is that the use of tractor enables agricultural operations to be conducted in a more timely manner. There is also no conclusive data to show that the cost of agricultural operations per acre by tractors is cheaper than cultivation by bullocks. But with large holdings, a combination of tractors and bullocks might become more economical.

Various farm machinery and power-driven implements, like ploughs, harrows, drills, harvesters, etc., are described in Chapter II and the functions of different implements are also

given. In Chapter III which deals with the selection and maintenance of equipment, the conditions under which the different types of tractors that should be used and the functions and detailed structure of different machines is given. The organisational aspects are described in great detail in Chapter IV. This chapter deals with the ideal set up of the organisation, how the organisation should be split up into units and the details of the equipment necessary for each unit. Information is also provided of the staff required, methods of collecting data and utilising such data.

While points that should be taken into consideration in selecting a suitable machine are discussed, it is still unrealistic to expect Indian farmers to do the testing before final choice is made of the particular type required. This has to be done only by the Government department and although information on the suitability of machines for particular types of work is already available, as for instance work involved in soil conservation, it cannot be said that we have still data to recommend to the farmers as to what particular type of machine he should purchase with reference to his soil and cropping conditions. The book can be of great value to technicians rather than to farmers.

K. R.

British Medical Bulletin—Causation of Cancer. Vol. 14, No. 2. (Medical Department, the British Council, 65, Davies Street, London W. 1). May 1958. Pp. 73-196. Price 25 sh.

This special number comprises of 21 papers by 27 leading research workers of Great Britain and the Commonwealth. The subject-matter may be broadly divided under four headings:

(i) Chemical Carcinogenesis, (ii) Occupational Carcinogenesis, (iii) Radiation Carcinogenesis and (iv) The Dynamic Aspects of Carcinogenesis.

(i) *Chemical Carcinogenesis.*—Prof. A. Haddow in his introduction has first outlined general progress of work on the causation of cancer during last eleven years and then authoritatively surveyed the subject of chemical carcinogenesis of hydrocarbons, azo compounds and aromatic amines. Although the field of cancer in general is too full with theories and working hypothesis, Prof. Haddow's critical appraisal of some of the current concepts of carcinogenesis facilitates much clearer understanding of the problem.

Dr. Boyland has critically examined biological aspect of carcinogen testing.

Dr. Orr in his short paper on irreversible changes in chemical carcinogenesis has presented his views on the latent period in chemical induction of skin cancer. Salaman has reviewed work on co-carcinogenesis since 1947 and has discussed the present position of the multistep theory. Peacock, himself an active investigator in the field of avian carcinogenesis, has traced the development of our knowledge in this field since the first successful experimental induction of sarcoma by Rous in 1911.

Belschowsky and Horning have carefully discussed the mechanism of carcinogenesis in various tumours of endocrine organs as pituitary, ovary, adrenal, testes, etc., as well as in the disease of other tissues as kidney, bone, liver, leukaemia, etc., indirectly controlled by hormonal imbalance.

(ii) *Occupational Carcinogenesis*.—In occupational carcinogenesis exogenous factors responsible for the causation of lung cancer have been reviewed by Kennaway and Lindsey. The paper covers chemical investigations on tobacco, tobacco smoke and town air in relation to the incidence of cancer of the lung and respiratory tract. Lately mineral oil carcinogenesis and azo compounds and aromatic amines of dyestuff industry have been attracting considerable attention and this has been covered by Cook, Carruthers and Woodhouse and also by Walpole and Williams.

(iii) *Radiation Carcinogenesis*. In radiation carcinogenesis, valuable data of Court-Brown on incidence of leukaemia among the survivors of atomic explosions and on patients irradiated for diagnostic or therapeutic purposes should be of great interest, because of increasing awareness of radiation hazards. Glucksmann reports the yield of skin tumours induced by irradiation in varying doses and compares them with carcinogen induced skin tumour and its induction period. The work of Doniach in experimental induction of thyroid tumours can be applied to that of hyperthyroid patients treated with I^{131} and role of pituitary for the secretion of thyroid stimulating-hormone (TSH) is further stressed.

(iv) *Dynamic Aspects of Carcinogenesis*.—Dynamic aspects of chemical carcinogenesis in relation to metabolism and excretion of carcinogens, their growth inhibiting and enzyme inhibiting action and tissue metabolism are discussed by Elson.

Prof. Green has elaborated his concept of immunological basis of carcinogenesis in the light of relevant literature. The origin of this theory is in the tumour-inhibiting (TI) action

of carcinogenic polycyclic hydrocarbons on some transplantable tumours. The hypothesis of protein binding nature of carcinogen—confirmed by several other workers—is taken as the basis and this binding is presumed to change protein complexes of the cell and with it a certain degree of isoantigenic loss, because of which the new race of cells does not recognize growth-regulating mechanism—the condition ultimately leading to uncontrolled neoplastic growth. The hypothesis now appears much more acceptable and thought-provoking.

The material on various aspects of 'Causation of Cancer' so neatly arranged, is a valuable reading for every worker in the field of Cancer Research, for proper understanding of the newer concepts of the problem of carcinogenesis.

KAMAL J. RANADIVE.

Books Received

- Nuclear Reactor Physics—A Practical Text and Guide for Design Analysis of Nuclear Reactors*. By R. L. Murray. (Macmillan & Co., London W.C. 2), 1959. Pp. xi + 317. Price 30 sh.
- Differential Thermal Analysis as Applied to Building Science*. By V. S. Ramachandran and S. P. Garg. (Central Building Research Institute, Roorkee). Pp. vii + 182.
- Fallacies in Mathematics*. By E. A. Maxwell. (Cambridge University Press, London N.W. 1), 1959. Pp. 95. Price 13 sh. 6 d.
- Modern Fishing Gear of the World*. By H. Kristjansson. (Fishing News Books Ltd., 110, Fleet Street, London E.C. 4), 1959. Pp. xxxi + 607.
- Synthesis of β Amino, $\alpha\beta$ Unsaturated and Bis-(Aminoaryl) Sulphones*. By M. Balasubramanian. (The Registrar, Annamalai University, Annamalai-nagar). Pp. iv + 89.
- Solvent Extraction of Vegetable Oils*. By H. V. Parekh. (The Secretary, Indian Central Oilseeds Committee, Hyderabad-1-Dn.), 1958. Pp. xi + 210.
- The Varaspathi Industry*. By Gopal, S. Hat-tiangdi. (The Secretary, Indian Central Oilseeds Committee, Hyderabad-1-Dn.), 1958. Pp. v + 100.
- Bacteriophages*. By M. H. Adams. (Interscience Pub., Inc., New York-1), 1959. Pp. xvii + 592. Price \$ 15.00.
- The Chemistry of Natural Products, Vol. II. Mono and Sesquiterpenoids*. 1959. Pp. vii + 320. Price \$ 7.50; Vol. III. *The Higher Terpenoids*. By P. De Mayo. Pp. vii + 239. Price \$ 6.00. (Interscience Pub., New York-1).

SCIENCE NOTES AND NEWS

The Green Bee Eater as Predator of the Desert Locust

Shri Charan Singh (Locust Warning Officer, Churu, Rajasthan) writes that he often observed the Green Bee Eater (*Merops orientalis*, Latham.) feeding on adults and hoppers of the desert locust (*Schistocerca gregaria*, Forsk.) in Bikaner and Sri Ganganagar districts of Rajasthan from 1953-56. On the 20th August 1953 during the course of locust survey it was observed at Rajasar Village of Churu District that a Green Bee Eater followed an individual of the desert locust adult high in the sky upto the height of 800 feet with great agility and returned to its perch with prey which was devoured. The object of this note is to record an important predator of the desert locust, in Rajasthan, in addition to the birds listed by Husain and Bhalla (1931).

Control of Fruit Drop in Mango

Messrs. K. Kirpal Singh, Sucha Singh and Krishna Lal Chadha report from Panjab that fruit drop in mango could be controlled by spray treatment with the plant growth regulators alphanaphthaleneacetic acid (NAA) and 2, 4-dichlorophenoxy-acetic acid (2, 4-D). The treatments were tried on Fajri mangoes on May 15, six weeks after full bloom. NAA at 30 and 40 p.p.m. in water gave the best control of fruit drop registering only 22% fruit-fall between May 15 and July 18 as compared with 52% in control during the same period. Application of 2, 4-D at 10 p.p.m. gave a fruit drop of about 28% and further increase in its concentration showed no better control.

Both the growth substances influenced fruit quality by increasing fruit size, titratable acidity and ascorbic acid content, and suppressed to a great extent, the oozing out of sap from the pedicel which commonly blemished the surface of untreated fruits. Some treated fruits also exhibited a red blush on yellow ground near maturity as against the normal green colouration of the ripe fruit in this variety.

Fifth Congress on Theoretical and Applied Mechanics

The above Congress will be held under the Presidentship of Dr. A. N. Khosla, Vice-Chancellor, University of Roorkee, from December 23 to 26, 1959, at the University of Roorkee, Roorkee.

Research Papers may be contributed on any of the following topics: (1) Elasticity—Plasticity—Rheology, (2) Fluid Mechanics, (3) Mechanics of Solids, (4) Statistical Mechanics—Thermodynamics—Heat Transfer, (5) Mathematics of Physics, Statistics and Computation, (6) Experimental Techniques, and should reach the Secretary-Treasurer with three copies of their abstracts before October 15, 1959.

There will be invited addresses of one-half hour each on special topics. The Registration Fee for the Congress is Rs. 10.00 which should be sent to the Secretary-Treasurer at Kharagpur.

The Congress will be preceded by a Symposium on 'Non-linear Physical Problems' under the joint sponsorship of the Indian Society of Theoretical and Applied Mechanics and UNESCO, on December 21 and 22, 1959. Invitations are being extended to foreign and Indian participants.

Application Forms for registration and any other information may be obtained from the Secretary-Treasurer, Dr. B. R. Seth, Indian Institute of Technology, Kharagpur.

Award of Research Degree

Andhra University has awarded the D.Sc. Degree in Physics to Shri H. S. Rama Rao for his thesis entitled "Ultrasonic Studies in Liquid Media", the D.Sc. Degree in Botany to Smt. H. Maheswari Devi for her thesis entitled "Embryological Studies in Compositae and Gentianales" and the D.Sc. Degree in Geology to Shri B. B. G. Sarma for his thesis entitled "Studies on Depositional Environments of Some Sedimentary Formations".

Osmania University has awarded the Ph.D. Degree in Chemical Technology to Shri B. V. S. Subba Rao for his thesis entitled "Studies on Thermal Decomposition of Limestones" and the Ph.D. Degree in Chemistry to Shri R. Kurdukar for his thesis entitled "Search for New Insecticides: Synthesis of Some Substituted Xanthenes, etc."

The University of Madras has awarded the Ph.D. Degree in Chemistry to Miss Roshan J. Irani for her thesis "Carbohydrate Constituents and Sugar Metabolism of *penicillium chrysogenum*". Miss Irani worked under Dr. K. Ganapathi in the Hindustan Antibiotics, Pimpri.

Weather Balloon Altitude Record

An experimental weather balloon of the U.S. Army, launched on February 11, 1959, reached a height of 1,46,000 ft (about 28 miles). The balloon was made of a new synthetic neoprene compound resistant to tears, extreme temperatures and the intense sunlight. During the flight which took two hours the balloon expanded from a diameter of 10 ft. to one of 65 ft. It carried a radio-equipped package containing weather instruments and a special type of altitude meter. The instruments recorded a low temperature of -85°F. at an altitude of 10 miles. At higher altitudes, the radio signals revealed a warming trend reaching 45°F. at the record height.—[*Bull. Am. Met. Soc.*, 1959, 40 (5), 262].

Vanguard I Photographed

The Smithsonian Optical Tracking Station at Woomera, Australia, has successfully photographed the Vanguard I earth satellite at the apogee of its orbit, nearly 2,500 miles from the earth. No other object as small as this 6-inch sphere has been photographed from such a distance.

Infra-red Hygrometer

The infra-red hygrometer, the method of measuring humidity by absorption spectra analysis, has been developed to the point where it now offers attractive possibilities to the meteorologist in special problems where conventional methods prove inadequate and higher cost of instrumentation will be justified.

R. C. Wood describes in *Bull. Amer. Met. Soc.*, June 1959, a relatively uncomplicated instrument in which the energy attenuation in the 2.6μ water band is related to the concentration of water vapour in the sensing path. The assembly consists of a source of infra-red radiation, a means for isolating selected wavelengths of radiation, the sensing path or absorbing column containing the atmospheric sample, and a radiation detector. Some areas of application for this technique are Micro-meteorology, Arctic meteorology and upper air meteorology which present special difficulties in the use of conventional methods.

Photographing the Sun by Ionized Helium Light

In March, the U.S. Naval Research Laboratory used a rocket to photograph the Sun's hydrogen atmosphere in ultra-violet light. The same group, led by Dr. Herbert Friedman, now plans to photograph the Sun's helium atmosphere—at even shorter ultra-violet wavelength. This

component of the solar "weather" lies farther out from the Sun's visible disc, where the outer layer of the chromosphere merges with the inner layer of the corona. From the photographs at various wavelengths, there is emerging a picture of increasing gas turbulence and rising temperature at increasing heights above the surface.

The March photograph by hydrogen light (Lyman-alpha line) showed a strikingly stormy Sun. If this pattern persists there should be bright emission from ionized helium, even though helium needs a temperature of $20,000\text{--}30,000^{\circ}\text{C.}$ to ionize, compared with $6,000\text{--}10,000^{\circ}\text{C.}$ for hydrogen. There is a practical side to this work: rays emitted from the Sun's ionized helium may be responsible for creating the upper region of the Earth's ionosphere, and it may become possible to plot the solar weather and predict terrestrial effects such as short-wave radio "black-outs".

Non-magnetic Alloy for Instrumentation in Magnetic Fields

Measurements made in the presence of magnetic fields frequently require portions of the measuring apparatus to be fabricated from nonmagnetic materials; such pieces, for example, as balance arms, sample holders, Dewar walls to be used between the poles, torsion fibres and galvanometer suspensions. These items are made of non-ferromagnetic materials such as copper, brass, silver, aluminium, lucite or quartz. Occasionally the small effects due to ferromagnetic impurities or even the intrinsic paramagnetic or diamagnetic moment of these materials become a problem.

A high-purity copper-nickel alloy of composition 96.3% copper and 3.7% nickel by weight, fabricated from copper rated 99.999% pure and nickel rated 99.997% pure, has been found to be completely non-magnetic. Experimental tests show the alloy to have zero magnetic moment at room temperature and less than a tenth of the magnetic moment of pure copper at all temperatures down to 2°K. The susceptibility of this alloy is found to be field independent from 0 to 24,000 oersteds. A method of preparing the alloy is described by E. W. Pugh in the *Rev. Sc. Inst.*, 29 (12), 1118.

Research on Radiation Effects on Bacteria

A research project to study the effects of radiation on bacteria has been sanctioned by the International Atomic Energy Agency. The object of this research is to contribute

to an understanding of the reasons why micro-organisms vary widely in their sensitivity to ionizing radiation and to examine how their radio-sensitivity can be increased. Such an understanding would be of value in the study of some fundamental problems of radio-biology and radiation protection. In the matter of preservation of food by irradiation, it is known that many bacteria possess a high level of resistance to ionizing radiation requiring for their destruction dosages which may prove harmful for the food itself. The problem will be to find a method to increase the radio-sensitivity of bacteria by some artificial means before they are subjected to radiation, so that a low radiation dose may prove completely effective and safe.

Dr. Peter Alexander of the Chester Beatty Research Institute, London, will guide this project in collaboration with the Microbiology Department of the Imperial College of Science and Technology in Kensington.

Chlorophyll from Nettles

The Forest Research Institute, Dehra Dun, in the Himalayan foothills, has developed a process for extracting chlorophyll as a copper derivative from the stinging nettles which grow in abundance in the temperate Himalayan tracks. Dried leaves of the plant, powdered finely, are extracted with ethyl alcohol after infusion with a solution of copper sulphate. The extract is concentrated in an acidic solution and refluxed in the presence of a suitable copper salt. The copper chlorophyll separates out from the solution and is eluted with hot water and purified.

Moon Relay Station

Using the moon as a passive relay station radio communication link was successfully established between U.K. and U.S. across the Atlantic in a series of experiments carried out between May 11 and May 14, 1959. The transmitting station was Jodrell Bank (U.K.) and the receiving station was the Air Force Cambridge Research Centre, Mass (U.S.). A 1-kW. FM transmitter working on 201 Mc./s. was used with the 250 ft. steerable radio telescope of Jodrell Bank. At the receiving end in U.S., the 84 ft. radio telescope was used with receivers of vari-

ous bandwidths from ± 2.5 to ± 10 kc./s. Similar receivers were also used on the telescope at Jodrell Bank for monitoring the local lunar returns.

Experiments lasting for about 40 hr. included transmission of audio tones up to 15 kc./s. and of messages by slow Morse, tests of intelligibility of speech and quality of music.

A number of major advantages may be expected from this lunar link system. Unlike conventional radio channels, this method will not be impaired by noise interference and blackouts caused by disturbances in the ionosphere. In addition, the new system opens up a whole new spectrum of frequencies in the already overcrowded radio channels for long range communication. The commercial interest in this field will no doubt stimulate further developments.

Marine Bacteria and Deuterium Concentration in Sea Water

In the course of studies of the calcium carbonate deposits of the Bahama Banks, conducted by the U.S. Geological Survey, there was a chance discovery of a marine bacterium which produced hydrogen gas. The bacterium which occurred in high concentration within the superficial sedimentary layer was isolated and cultured using the sea-water dextrose as substrate. Mass spectrometric analysis of the gas generated by this micro-organism revealed an unexpectedly high percentage of light hydrogen (protium) and an apparent absence of the normal isotope, deuterium, in the gas mixture. Subsequent analysis of the sea-water dextrose substrate showed the normal distribution of the protium-deuterium isotopes. It was apparent that the deuterium in the medium was being selectively fractionated by the cellular biochemical processes.

An understanding of these processes involved in separation and concentration of deuterium may have economic importance, as for instance in the production of heavy water. Of academic interest is the possible significance of the role of marine bacteria in the concentration of heavy water in the seas during past geologic time. Today, sea-water contains from 10 to 25% more D_2O than fresh water, the atmosphere, ice, and igneous rock.—*Science*, 1959, 129, 1288.

RECENT TRENDS IN CRYSTALLOGRAPHY

THE experimental determination of a crystal structure consists of two distinct steps: (i) the determination of the symmetry of the crystal, i.e., the type of its lattice and its space group and (ii) the determination of the atomic arrangement which is consistent with this symmetry and which will satisfactorily account for the intensities diffracted by the different "atomic planes" inside the crystal. The determination of the space group is not altogether a straightforward procedure. Some of the symmetry elements which incorporate the operation of a translation like the screw axis or the glide plane can be recognized by systematic absences in the X-ray reflections. Even here an ambiguity may be introduced because it may happen that extinction in a more general class of spectra may automatically imply extinctions in a less general class. Apart from this there is an inherent difficulty in the determination of space group because X-ray diffraction being of the Fraunhofer type cannot normally detect the presence or absence of a centre of symmetry. However, the expectation expressed by M. J. Buerger that the intensities themselves should provide the information necessary to unambiguously specify the space group has proved essentially correct. Wilson has shown that the presence or the absence of the centre of symmetry can be detected from the study of the distribution of intensities or by computing the average intensities in any particular zone. This statistical method works out most satisfactorily when there are a large number of light but equal atoms in the unit cell. A number of studies on the effect of heavy atoms on the intensity distribution curves have been made. It is now established that the method of local intensity averages can be used to detect such symmetry elements like two-fold axes, mirror planes, etc., which cannot be unambiguously determined from the direct inspection of X-ray diffraction photographs.

The other approach to the problem of the determination of the symmetry elements is through the information obtained from the concentration of peaks in certain planes in the three dimensional Patterson synthesis or in Harker sections. The possibilities of this procedure have been worked out. It is claimed that using these techniques it is now possible to identify 215 out of 219 non-enantiomorphous space groups. The enantiomorphous space groups can theoretically at least be distinguished from crystal morphology or by the use of anomalous scattering techniques. It must be remarked, however,

that while small ambiguities in the space group "have not proved to be a serious obstacle in the determination of crystal structures there is no doubt that the unequivocal determination of the space group at the outset may lead to more rapid and certain progress" (Lipson and Cochran).

Knowing the space group the crystal structure determination cannot, in general, be direct because the information regarding the relative phases of the reflection is lost during the recording of the diffraction spots. However, many complicated structures have been solved by the method of trial and error. Perhaps the most direct method of solving crystal structures would be the isomorphous substitution method. The solving of the structures of the phthalocyanines by J. M. Robertson is perhaps one of the most outstanding successes of this method. The extension of this method to non-centrosymmetric cases by Bijvoet and the development of the double isomorphous substitution method by D. Harker and others are expected to prove extremely fruitful in the determination of complex structures. Another direct method which has been so successfully developed and exploited by Buerger, Robertson and others is the vector set method. This method uses the Patterson synthesis or the method of auto correlation where every available observed datum is incorporated, there being no necessity for the inclusion of such doubtful quantities like the relative phases of the reflections. The principle of the method depends on the fact that when the vector set of points (the Patterson) of a fundamental set (the structure) is known, it is possible by "image seeking" methods, to recover from the vector set the original fundamental set. However, various techniques have been suggested to overcome the difficulties which arise on account of the physical fact that atoms having a spatial extension are unlike the fictitious mathematical points of a fundamental set.

A very important step in the analytical method of direct phase determination was made when Harker and Kaspar discovered that inequalities long known to mathematics (like that of Schwartz) could be applied to the problem of phase determination in at least centro-symmetric structures. Such an application is possible because the density of the scatterer at all points in any crystal (for X-ray diffraction) is always positive, a condition similar to that on which most of these mathematical inequalities are

based. This has been followed by a series of investigations but perhaps the most significant amongst these is the squared atom method of Sayre. This is based on the fact that in a structure of equal, well resolved atoms, if one considers an electron density function which is the square of the normal function, the resultant function would not be very different from the original one, except for a difference in the shape of the peaks. This concept leads immediately to product relationships such that if the structure amplitudes F_{pq} and $F_{h-p, k-q}$ are both large then F_{hk} is almost definitely the sign of their product. The most effective methods of utilising these relationships for the correct assignment of phases have been explored.

As yet no routine method seems to have been found for the solution of the phase problem. But such a claim has been made for the statistical method of Hauptman and Karle. It consists in applying the method of statistics—joint probability methods, to the observed amplitudes and intensities. *A priori* if the atoms whose positions are not known are assumed to be randomly distributed the probabilities of the sign of a reflection are equal. But given a certain set of observed intensities or amplitudes, these probabilities become different from one half each and depend not only on the observed intensities but also on certain quantities called mixed moments solely dependent on space groups. The solution of the structure of dimethoxybenzophenone recently may be said to be one of the outstanding successes of this method.

There is, however, an approach to crystallography which is completely different from the procedures given above. This is based on the pioneering work of Federov and Barlow who speculated about the structures of crystals based on simple packing considerations. The work of Federov on the filling of space with identical polyhedra having the same orientation is well known. He found that this was possible with five types of polyhedra. Later workers have considered the problem of filling space with regular and semi-regular solids either alone or in combination but without the Federov restriction on orientation. Further developments in this method have been associated in recent years with Goldschmidt, Pauling and Wells. These attempts at explaining crystal structure on the basis of packing, rather than the conventional methods of lattice and symmetry, are based on the following considerations, *viz.*, that it is possible to calculate quite generally the field of force around each atom

or other structural unit; it would then be possible to know its bonding requirements and hence one could proceed to compute the spatial arrangement of the lowest potential energy. This would normally be a compromise between the requirements of different kinds of atoms, if more than one kind are involved. If, for example, the field of force is spherical, one could expect the structural unit to form a closed packed structure. But one cannot directly predict which of the closed packed structures—cubic, hexagonal or the more complex varieties—will have the least energy.

A serious attempt to understand the principles underlying the structure of crystals on this basis has been made by Dr. A. F. Wells* and he has presented the experimentally determined crystal structures from the point of view of topology rather than the conventional approach of lattices and symmetry. The procedures adopted by him are somewhat on the following lines. When considering the structure of a substance having a particular formula instead of following the conventional practice of discussing all the known structures of substances of similar formula-type, an attempt is made to derive all the simple structures possible for this formula consistent with the requirements of the atoms involved (like co-ordination number, number of bonds per atom, etc.) and then to discuss the observed structure against this background of crystal geometry. To do this a very careful survey has been made by him of the basic geometry underlying the structure of crystals, the nature of periodic network of connected points, etc. It has even been necessary also to develop the theory of three dimensional networks. Wells not only considers the cases of space filling polyhedra but also those of open packings of polyhedra, close and open packing of equal and unequal spheres. It would be very difficult to give a brief summary of Wells' work but it is indeed most impressive to note how many of the so-called complicated structures make use of extremely simple structural themes. There can be no doubt that this approach to crystallography would prove so fruitful that it should form the subject of intensive study by every serious crystallographer.

S. RAMASESHAN.

* *Solid State Physics*, Vol. 7. Edited by F. Seitz D. Turnbull. (Academic Press, New York, India: Asia Publishing House, Bombay-1), 1958. Pp. xiv + 525. Price \$ 14.00.

BIOGENESIS OF BENZOQUINONES AND RELATED SUBSTANCES

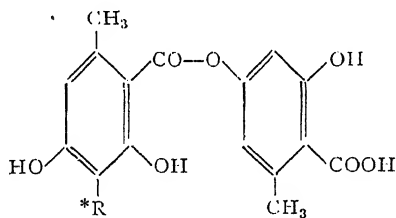
S. NEELAKANTAN AND T. D. SESHADRI

Department of Chemistry, University of Delhi, Delhi-8

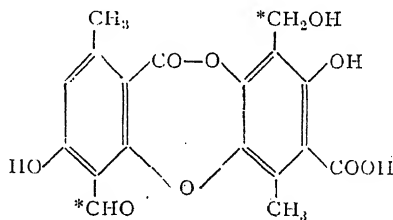
AMONG natural products, benzoquinone derivatives form an important group. They occur widely and a large number of them have been isolated as metabolic products of moulds, fungi, higher plants and insects. Their antibiotic properties are of current interest though the simpler members like fumigatin are known to be toxic. Some of the bigger compounds like embelin are components of drugs and others may have nutritional function (*e.g.*, ubiquinones). They form components of oxidation-reduction systems and can undergo easy reduction to the quinol derivatives which sometimes occur along with the quinones as natural products (*e.g.*, fumigatin and its corresponding quinol). From their large occurrence there is indication of appreciable stability; however they are highly reactive compounds capable of undergoing substitution and also polymerization.

The biogenesis of a large number of benzoquinones seems to have the C_8 -unit as the origin. The C_8 -unit scheme was first formulated¹ for the large number of depsides (I) and depsidones (II) occurring in lichens. In these compounds the presence of C_8 -units is quite as obvious as the C_6 -units in starch and cellulose. The simplest orsellinic unit (III) is found to undergo a number of modifications involving ordinary oxidation and reduction (*e.g.*, IV & V) and also nuclear oxidation (VI) and nuclear methylation (II). Another characteristic feature is the lengthening of one of the side chains (6-position; see VII) of the original C_8 -unit. The newly entering alkyl group also can have large dimensions, a feature noticed more commonly in mould products.

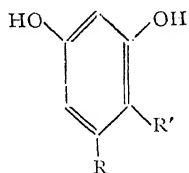
The recent work^{2,3} on the mechanism of the biogenesis of citrinin (VIII) using tracer



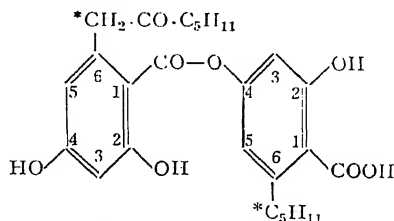
I R = H: Lecanoric acid
VI R = OH: Diploschistesic acid



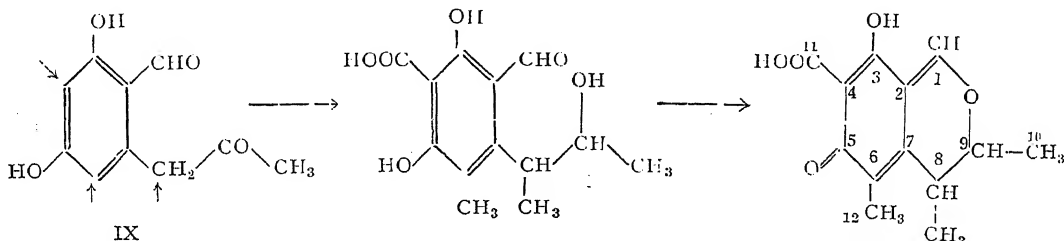
II Protocetraric acid



III R = CH₃; R' = COOH
IV R = CH₂OH; R' = CHO
V R = R' = COOH



VII Physodic acid



technique fully supports the earlier suggestion¹ based on the C_8 -unit according to which the carbon atoms numbered 11, 12 and 13 are the result of entry of single carbon units. The precursor could be visualized as a keto compound (IX) which can undergo C-methylation not only in the benzene nucleus but also in the particular active centre of the side chain.

The quinones can be considered under a number of heads based on the complexity of the compounds.

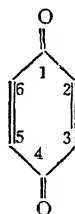
1. TOLUQUINONE DERIVATIVES

In the earlier paper by Aghoramurthy and Seshadri,⁴ the similarity between the metabolic products of lichens and moulds was pointed out and the C_8 -unit scheme was shown to be applicable to the toluquinones of fungal origin.

As typical examples, the biogenesis of methoxy-toluquinone, fumigatin, spinulosin and aurantiogliocladin was explained and this was supported by the laboratory synthesis⁵ of these compounds starting from C_8 -unit systems.

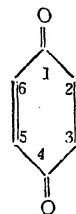
Simple toluquinone and its *o*-hydroxy derivative, gentisylquinone, lack the presence of nuclear hydroxyl groups. They could have the same origin as fumigatin except for the incidence of stages of nuclear reduction. The common occurrence of $-CH_2OH$ group as in gentisylquinone has already been pointed out. Two possibilities exist: (i) hydroxylation of the active methyl group or (ii) hydroxymethylation being the earlier stage undergoing reduction to a methyl group. The co-occurrence of *o*- and *p*-xyloquinones and trimethylbenzoquinone

TABLE I



Compound	Position of substituents	Source
1 Toluquinone	.. 2-Methyl	Flour beetles
2 Gentisylquinone	.. 2-Hydroxymethyl	<i>Penicillium patulum</i> , <i>P. divergens</i>
3 <i>o</i> -Xyloquinone	.. 2 : 3-Dimethyl	Arachnids
4 <i>p</i> -Xyloquinone	.. 2 : 5-Dimethyl	do.
5 Trimethylbenzoquinone	.. 2 : 3 : 5-Trimethyl	do.
6 Methoxytoluquinone	.. 5-Methoxy-2-methyl	<i>Coprinus similis</i> , <i>Lentinus degener</i>
7 Fumigatin	.. 6-Hydroxy-5-methoxy-2-methyl	<i>Aspergillus fumigatus</i>
8 Spinulosin	.. 3 : 6-Dihydroxy-5-methoxy-2-methyl	<i>A. fumigatus</i> , <i>Penicillium spinulosum</i> , <i>P. cinerascens</i>
9 Aurantiogliocladin	.. 5 : 6-Dimethoxy-2 : 3-dimethyl	<i>Gliocladium</i> spp.

TABLE II



Compound	Position of substituents	Source
1 Embelin	.. 3 : 6-Dihydroxy-2-undecyl	<i>Embelia</i> spp., <i>Myrsine</i> spp., <i>Rapanea neurophylla</i>
2 Rapanone	.. 3 : 6-Dihydroxy 2-tridecyl	<i>Rapanea maximowiczii</i> , <i>Oxalis purpurea</i> var. <i>jacquini</i>
3 Mæsaquinone	.. 3 : 6-Dihydroxy-5-methyl-2-nonadecyl	<i>Mæsa japonica</i>
4 Ubiquinones	.. 5 : 6-Dimethoxy-2-methyl- 3-[CH ₂ -CH=C-CH ₂] ₆₋₁₀ .H | CH ₃	Pig's heart, baker's yeast
5 Ethylbenzoquinone	.. 2-Ethyl	Flour beetles

would suggest that they have resulted by the further nuclear methylation of toluquinone (by free radical process) or of the corresponding quinol (by ionic reactions or formaldehyde condensation). The importance of these methylbenzoquinones in relation to vitamin E has been discussed by Rao and Seshadri⁶ and this will be mentioned again later on.

2. TOLUQUINONES WITH LENGTHENED SIDE CHAIN

Embelin (X) is a derivative of 3:6-dihydroxy-2-methylbenzoquinone and its biogenesis from the appropriate C_8 -unit (XI) can be represented as given below. Rapanone (XII) differs only in having a longer side chain and mæsaquinone (XIII) contains an extra methyl group and the position occupied by this is the normal γ -position of the orsellinic (C_8 -) unit.

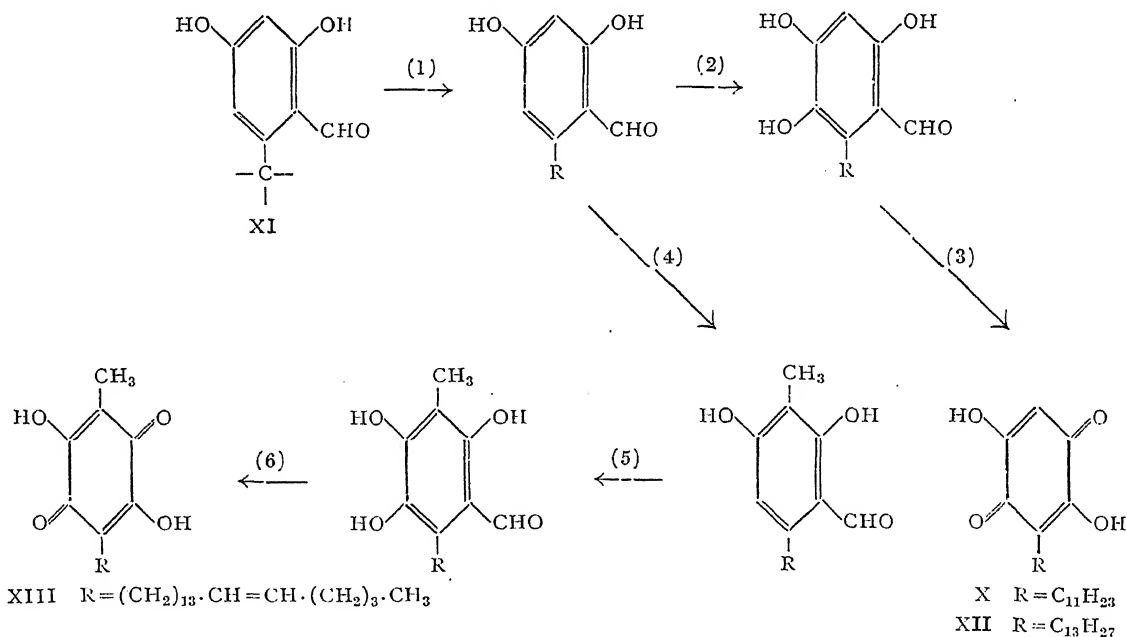
Ubiquinones (XIV) can be more directly

derived from 5:6-dimethoxy-2-methylbenzoquinone (fumigation methyl ether) (XV) involving substitution in the 3-position by isoprene system. This is analogous to what is found in the case of vitamin K_2 .

Ethylbenzoquinone, though a simple molecule, is somewhat exceptional in having an even (two carbon) side chain but it could be included in the toluquinone group if a propionic acid side chain (C_3) could be considered to undergo decarboxylation. This feature is commonly found in the porphyrin series where the propionic acid and ethyl side chains are found.

3. TOCOPHEROLS

A number of tocopherols have been isolated from vegetable oils like wheat germ oil and cotton-seed oil and also from leafy vegetables (Table III).



Reactions: (1) Chain lengthening; (2) *Para* nuclear oxidation; (3) *Ortho* nuclear oxidation; (4) Nuclear methylation; (5) *Para* N.O.; (6) *Ortho* N.O.

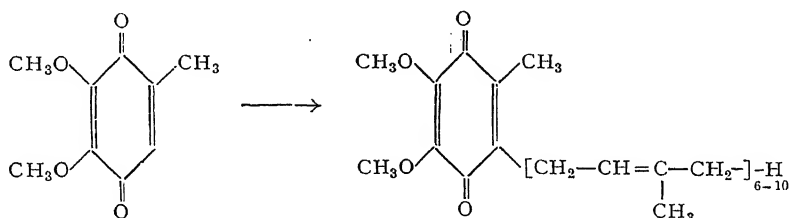
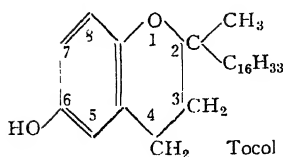


TABLE III



Compound	Position of substituents
1 α -Tocopherol	5 : 7 : 8-Trimethyl
2 β -Tocopherol	5 : 8-Dimethyl
3 γ -Tocopherol	7 : 8-Dimethyl
4 δ -Tocopherol	8-Methyl
5 ϵ -Tocopherol	5-Methyl
6 η -Tocopherol	7-Methyl
7 ξ -Tocopherol	5 : 7-Dimethyl

The relationship between the simple methyl substituted benzoquinones (Table I) and the tocopherols (Table III) is quite suggestive. It would appear that the corresponding quinols are the important intermediates. In plants, they undergo condensation with phytol to yield the tocopherols whereas in insects they undergo oxidation giving the corresponding quinones. The occurrence of the related series in the two places is highly significant.

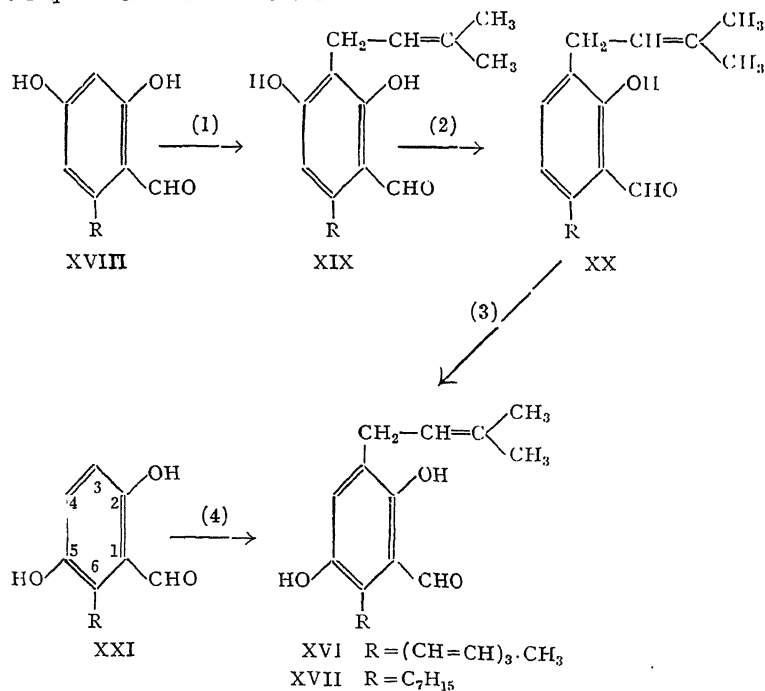
4. QUINOL DERIVATIVES

Two mould products which are closely related to the toluquinone derivatives are auro-

glaucin and flavoglaucin. Their constitutions have recently been revised⁷ as (XVI) and (XVII) respectively and the new structures fall into the C_N -unit scheme better. The main steps are chain lengthening (XVIII), nuclear prenylation (XIX) in the 3-position followed by nuclear reduction (XX) and *para* nuclear oxidation (XXI & XXII). In the orsellinic unit, entry of alkyl and other electrophilic groups is facile in the 3-position located between the two hydroxyl groups and hence the above suggestion (reaction 1). However, since reactive groups like the prenyl attack the quinol systems' also easily, the alternative prenylation of the alkyl substituted gentisic aldehyde (XXI) cannot be excluded. In this case, the 3-position will get preferentially activated by the *para* alkyl whereas the 4-position will be deactivated by the *para* aldehyde and hence the formation of the compounds (XVI & XVII) can be explained.

Benzoquinones of other origins

Though C_N -units occur widely and there is great validity for the C_N -unit origin of a large number of quinones and their derivatives, the scheme should not be pressed into service everywhere indiscriminately. There seem to be simpler and more natural alternative routes m



Reactions : (1) Nuclear prenylation ; (2) Nuclear reduction ;
(3) *Para* nuclear oxidation ; (4) Nuclear prenylation.

many other cases. Some typical examples are given below.

1. Simple benzoquinone derivatives

2. Terphenylquinones.—A number of these compounds are known (Table V) and the more recent members to be recognised under this

TABLE IV

Compound				Source
1	Benzoquinone	..	..	Insects
2	Methoxybenzoquinone	..	..	Wheat germ
3	2:5-Dimethoxybenzoquinone	..	..	<i>Polyporus fumosus</i>
4	2:6-Dimethoxybenzoquinone	..	..	Wheat germ, <i>Adonis vernalis</i>

These are lacking in C-methyl groups and have methoxyl groups instead. A natural derivation would be from inositol (XXII) which is widely occurring in Nature and which can undergo ready oxidation to inosose and tetrahydroxy-*p*-benzoquinone (XXIII). These oxidations can be carried out fairly readily by means of nitric acid; further they are known to be effected by micro-organisms also.⁹ From the tetrahydroxyquinone (XXIII), graded loss of hydroxyl groups followed by methylation would account for the abovementioned compounds.

group are thelephoric acid (XXIV) and volucrisporin (XXV).

The biogenesis of this group of quinones has been suggested by Seshadri¹² as involving the linking of two C₆-forked units. Thelephoric acid (XXIV) and volucrisporin (XXV) are of special interest. Thelephoric acid was formerly considered to be a phenanthrene-quinone pigment, but recent work has shown that this structure needs change. It probably contains two methylenedioxy groups and belongs to the terphenyl series. Volucrisporin (XXV) has no *para*-

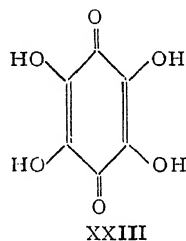
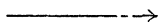
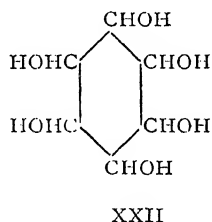
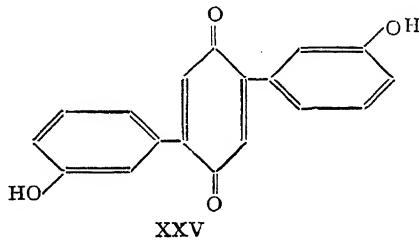
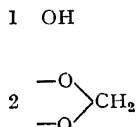
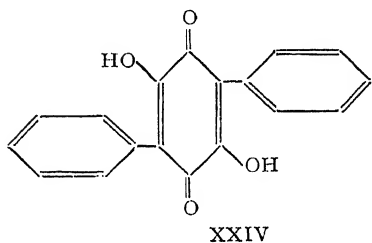


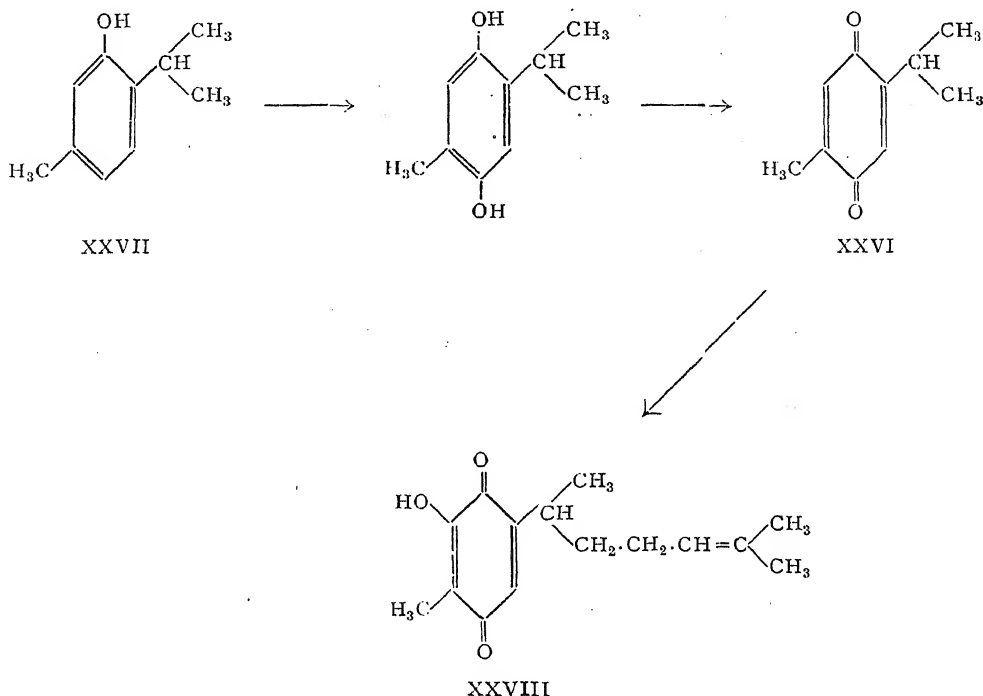
TABLE V

Compound				Source
1	Polyporic acid	..	..	<i>Polyporus nidulans</i> , <i>P. rutilans</i> , <i>Penisphora filamentosa</i> , <i>Sticta coronata</i> , <i>S. colensoi</i>
2	Atromentin	..	..	<i>Paxillus atrotomentosus</i>
3	Leucomelone	..	..	<i>Polyporus leucomelas</i>
4	Muscarufin	..	..	<i>Amanita muscaria</i>
5	Thelephoric acid ¹⁰	..	..	<i>Thelephora palmata</i> , <i>Lobaria isidiosa</i>
6	Volucrisporin ¹¹	..	..	<i>Volucrispora aurantiaca</i>



dihydroxy group and possesses a *meta*-hydroxy-phenyl system. It seems to be possible that a catechol system is the real precursor and both the *para* and *meta* hydroxy compounds arise by selective reduction at some stage.

and (iv) quinol derivatives. However, simpler benzoquinone derivatives, terphenylquinones and thymoquinone derivatives have other origins, e.g., inositol, C₉-units and terpenoid systems.



3. *Thymoquinone derivatives*.—Compounds belonging to this group seem to be rather exceptional. Thymoquinone (XXVI) itself occurs in the seeds of *Carum roxburghianum*, heartwood of *Tetraclinis articulata* and in the incense cedar. Hence it is natural to expect that it is derived from thymol (XXVII) by oxidation. Therefore it has a terpene origin. A compound which seems to be closely related to thymoquinone would be perizone (XXVIII). The additional stages involved are chain lengthening of the C₃-system by means of an isoprene unit and introduction of a hydroxyl group.

SUMMARY

The C_n-unit scheme satisfactorily accounts for the biogenesis of (i) toluquinone derivatives, (ii) extended toluquinones, (iii) tocopherols

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ON THE USE OF THE TERM "CHARNOCKITE DYKE"

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THE term 'charnockite dyke' has often been used somewhat loosely to designate basic dykes which contain hypersthene irrespective of their field relations or the metamorphic grade attained by such rocks. There are basic dykes of different ages and of many petrographic types in the charnockite province of India—varying from epidiorites to granulites. Some of the dolerite dykes are hypersthene-bearing, and some contain olivine. It is necessary, therefore, to be clear about the differences which exist among basic dykes which contain minerals normally found in charnockites, but which have had different modes of origin.

When Holland published his classic memoir in 1900 on the Charnockite Series of South India, he not only described massive outcrops, but also referred to the occurrence of these rocks as dykes. He observed that they are often found as 'bands' with sharp boundaries, and running parallel to the foliation of the biotite gneiss in which they lie. They do not exhibit glassy or felsitic selvages, though the borders are sometimes more compact than the interior. The texture is granulitic, but the rocks are finer in grain than the average massive form of the charnockite series. Holland considered that this difference in grain was just the same in degree and kind as would be seen between a large stock of gabbro and its corresponding dolerite dyke phase. He thought that the presence of such dykes corroborated other evidences which, according to him, pointed to the igneous origin and intrusive behaviour of the charnockite series.¹

The exact date of publication of Wetherell's Memoir on 'The Dyke Rocks of Mysore' is not known but it was somewhere in the period between 1902 and 1905. In his four-fold classification of basic dykes, he considered 'Granulites' as the dyke equivalents of the basic charnockite series.²

'Dyke-like' inclusions of hypersthene granulites were noticed by Slater in the gneisses of Mysore State.³ Jayaram⁴ considered the dark finer-grained hypersthene-augite granulitic dykes as 'genetically related to the charnockite magma of a later period of consolidation'.

When geologically surveying the southern portion of Hassan District in Mysore State, Sampat Iyengar came across 'basic charnockites' occurring as 'thin parallel dykes' in the

gneiss. They generally exhibited a granulitic texture, but when coarse-grained they had a peculiar greasy appearance. He believed that these dykes in the south-west corner of Hassan District were connected with the massive bodies of basic charnockites that occur in Coorg and its neighbourhood.⁵ He noticed that these dykes are sometimes cut across by pink granite veins, and that in a few places they occur for some distance as irregular disconnected patches in the granite.

Later, Jayaram, in his report on the Closepet granites and associated rocks, considered that the end phase of the charnockite magma was represented by a number of hypersthene-bearing granulite dykes which were intruded into parallel fissures.⁶ He also recorded that the hypersthene-bearing dykes, like the hornblende granulites, did not show any marked chilled edges, though sometimes finer, crushed and more hornblendic portions characterized the edges of these dykes.⁷

Smeeth⁸ also considered that the charnockites which form the great mass of the Nilgiris 'come into Mysore on its eastern, southern and western borders where they are found distinctly penetrating the Peninsular gneiss both as tongues and as basic dykes'.

Rama Rao,⁹ on the contrary, found that 'the region which has been mapped as showing tongues of the charnockites forking into their adjacent Peninsular gneiss resolves into an inter-banded series of charnockites and biotitic gneisses; and the former does not transgress anywhere the strike of foliation of the gneissic granites'.

Rama Rao later stated that the types which have been mapped in Mysore State as the dyke phases of the charnockite series, though megascopically similar, disclosed much variation in their textural details. He grouped them broadly into olivine norites and granulitic hornblende norites, but observed that while they showed a striking general resemblance to the basic charnockites, especially in their mineral composition, they differed in several minor details not only from the latter but even among themselves.¹⁰

It was Rama Rao, however, who for the first time visualized the possibility of some of the basic intrusives developing a granulitic texture and passing on 'by progressive stages to a

hornblende hypersthene biotite granulite, hardly distinguishable from a typical basic charnockite'.¹¹

On going through the literature, it appears that the earliest occasion in Mysore when the post-Archæan basic dykes were confused with the earlier ones was in 1911 when Sampat Iyengar, after describing typically granulitic dykes, goes on to say that the fine-grained dykes

The writer would like to propose the discontinuance of the term 'charnockite dyke' as it suggests a magmatic origin. If it is to be used at all, it should be confined to describe rocks of charnockitic regions which have the following characters:—

1. *Mode of occurrence*.—Parallel bands or dyke-like masses, generally not showing cross-cutting relations with gneissic rocks.^{1,9} Where

Photomicrographs of granulitic dykes

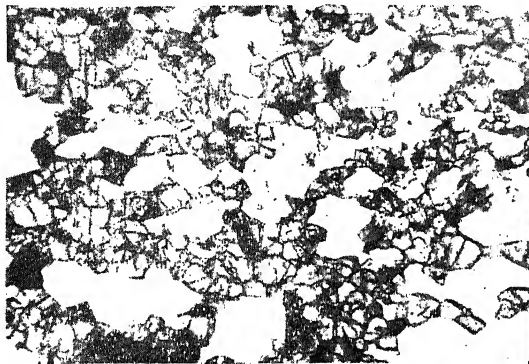


FIG. 1. The classic Fraserpet dyke described by Holland, which outcrops on the bed of the river Cauvery on the Coorg-Mysore border. Note the granulitic texture, rough banding, and water-clear nature of the feldspars. $\times 9$.

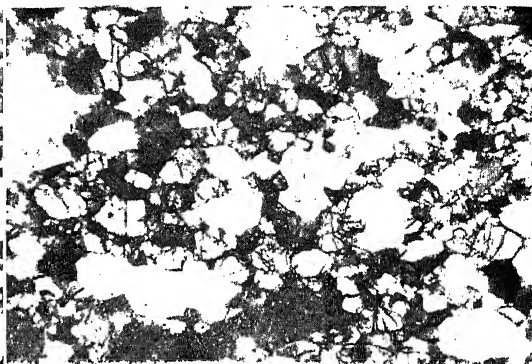


FIG. 2. The same section as in Fig. 1, between crossed nicols. The plagioclases are seen to be generally untwinned. $\times 9$.

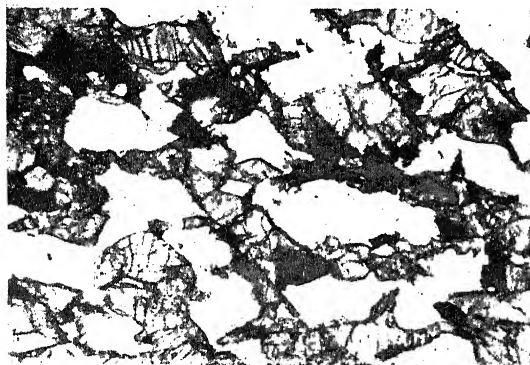


FIG. 3. Dyke, near Talkad, Mysore State. The pyroxenes and brown hornblendes are drawn out into somewhat parallel bands. The feldspars are clear and unclouded. $\times 9$.

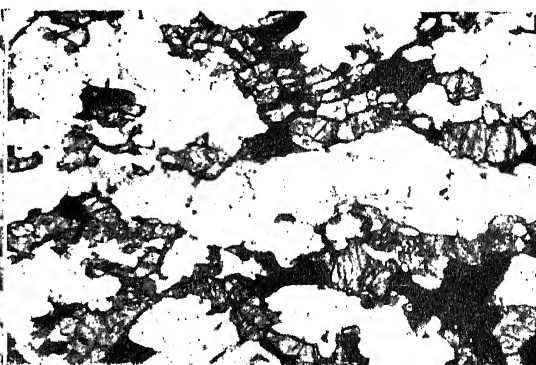


FIG. 4. Dyke from the Shevaroy Hills, Salem District, Madras State. The minerals are disposed in roughly parallel streaks. There is no clouding of the feldspars. $\times 9$.

are often highly hornblendic, and that in many sections hypersthene granules are unrecognizable when, according to him, it becomes a matter of considerable difficulty to distinguish such rocks from the fine-grained hornblende schists.¹² Since then, it is apparent in the writings of many others that some of the later dykes have often been considered to have been related to the charnockites.

such rocks transect the prevailing foliation, the dyke-like runs are cut up, and enclosed by granites and gneisses.^{5,13}

2. *Structure*.—Sharp contact with country rock but with no glassy or felsitic selvage.^{1,7}

3. *Texture*.—Though granulitic, there is generally a rough banding (Figs. 1, 3, 4). This feature was noticed quite early by Wetherell.¹⁴

4. *Feldspar*.—The plagioclases are free from clouding, and generally water-clear. There is no great tendency for twinning^{1,15} (Fig. 2).

The writer has recently put forward the suggestion that there are charnockites of two different ages, an earlier type formed by the regional metamorphism of pre-existing rocks, and a later type derived from metasomatism and rheomorphism.^{16,17} The former is gneissic or granulitic, and the latter granitic and coarse-grained.

In the light of the above explanation, it follows that these so-called charnockite dykes belong to the earlier phase when basic dykes of Dharwar age were regionally metamorphosed and reconstituted into granulitic or gneissic charnockites containing hypersthene and clear plagioclase.

The post-Archæan dykes of various petrographic types, some of which are hypersthene-bearing, have chilled against the charnockites of the earlier period, generally retained their igneous textures such as ophitic, and have had

clouding induced in plagioclase, pyroxene, and olivine, due to the regional thermal metamorphism caused by the later formed metasomatic charnockites.

The two groups of dykes can, therefore, be clearly distinguished by their field relations, texture, and clouding of minerals.

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LUNIK II—THE RUSSIAN MOON ROCKET

WHAT will go down as a remarkable achievement in the history of cosmic space rocketry was the successful launching by Russia of the Moon Rocket, Lunik II, which landed on the moon almost to the minute according to schedule, thus accomplishing the first space flight from the earth to another celestial body. The rocket was launched on the afternoon of Saturday, September 12, 1959. The final stage of the rocket hit the moon at 00 hours 2 minutes 24 seconds (Moscow Time) on Monday morning, September 14, 1959.

The rocket moved along a trajectory near to that calculated in advance and the time and place of its hitting the moon had been accurately forecast. The time of impact was to be at 1 minute 1 second past midnight, September 14, and the place of impact was to be in the triangular region of the moon's surface bounded by the Sea of Serenity, the Sea of Vapours and the Sea of Tranquillity.

The last stage was a guided rocket weighing 1,511 kg. (3,324 lb.), without fuel, and included scientific and measuring equipment, energy sources and container, of total weight 390 kg. (860 lb.). It contained a remote control device which would correct its "very small" deviation from the planned trajectory as it sped towards the moon. The accuracy of 1 minute 23 seconds on a journey of a quarter of a million miles proves a "tremendous achievement of radio navigation".

The rocket took approximately 34 hours to travel from the earth to the moon which was 374,000 km. (233,600 miles) away at the time of impact.

A sodium cloud emitted by the rocket on the first night of its flight was observed and photographed.

The rocket was sending back continuous radio signals and these were heard clearly but faintly until 20 minutes before it hit the moon. The signals began to fade badly and shortly afterwards were inaudible altogether, which was the indication that the rocket had landed on the moon. The giant radio telescope at Jodrell Bank kept track of the rocket till its impact "less than 90 seconds behind schedule".

The impact would not have been visible even through the world's most powerful telescope. A space ship hitting the moon would have to be at least 200 yards in diameter for the landing to be visible from the earth.

The Budapest Observatory, however, reported that at the time of the rocket's landing on the moon a black circle was noticed through the observatory's 7-inch refractor, on the surface of the moon in the region of the expected impact. The black ring remained visible for 58 minutes and is believed to be the moon's surface dust raised by the impact.

Special steps were taken to ensure that no earthly micro-organisms were carried to the moon by the rocket.

INDIAN INSTITUTE OF SCIENCE, BANGALORE—GOLDEN JUBILEE SYMPOSIA

AS part of the Golden Jubilee programme the different Departments of the Institute are holding a series of symposia during the year. Four symposia were held in August. They were on "Polarography" arranged by the Department of General Chemistry; "Biology and Biochemistry of Micro-organisms", "Enzymes" and "Vitamins" arranged jointly by the Departments of Biochemistry, Pharmacology and Fermentation Technology Laboratories. The symposia were inaugurated by Dr. S. Bhagavantam, Director of the Institute, and attended by delegates from centres of research in the respective fields of study all over the country.

SYMPOSIUM ON "POLAROGRAPHY"

The first day's proceedings were presided over by Dr. K. S. G. Doss, who delivered an address on the "Effect of surface-active substances on the dropping mercury electrode capacity". On the second day Dr. M. R. A. Rao gave a lecture on the "Importance of Diffusion Coefficient in Polarography" in which he emphasized on the need for measuring the diffusion coefficients under polarographic conditions for elucidating the correct reaction mechanism, particularly in complex reduction processes as occur in nitrophenols. Dr. R. S. Subrahmanya reviewed the polarographic work done at the Institute with respect to inorganic and organic polarography. He dealt particularly with the interpretation of irreversible polarographic waves. On the final day Dr. N. A. Ramiah spoke on "Polarographic Method of Determination of Stability Constants of Metal-chelate Complexes".

Sixteen papers were presented for discussion. Among contributions received from polarographers outside India were those by Prof. Kolthoff, by Prof. von Stackelberg, by Prof. Wawzonek and by Dr. Furness and their collaborators. These were presented by Dr. Subrahmanya for discussion.

Fifteen polarographic workers from different parts of India took part in the symposium. The discussions were mainly on the following aspects: The irreversibility of the polarographic waves, the effect of surface-active substances on polarographic wave-forms, the use of Ilkovic equation, the role of movement in explaining certain obscure phenomenon in polarography, correlation between the decrease in the double layer capacity and the efficiency of vapour phase corrosion inhibitors, precautions to be taken in employing linear diffusion method for diffusion coefficients, the care involved in standardising methods for estimating substances polarographically in presence of interfering

substances and the complications that would occur in organic reductions due to tar formation.

SYMPOSIA ON "MICRO-ORGANISMS", "ENZYMES" AND "VITAMINS"

These symposia were attended by over 200 scientists including 50 delegates from the various centres of biochemical research.

Major-General S. L. Bhatia who presided on the first day of the session, gave an address on the "Progress of Physiology and Biochemistry in India". The President for the second day Dr. P. S. Sarma gave an account of the contributions of the late Prof. K. V. Giri in the field of enzymes. On the third day Dr. V. N. Patwardhan in his presidential address presented a review of the mode of action of vitamin D—a field in which he himself has made significant contributions.

Dr. V. Subrahmanyan gave an account of the work carried out in the Department of Biochemistry during his long association with it. Prof. M. Sreenivasaya described the physico-chemical and ultra-micro methods developed by him for the study of enzyme systems.

There were four evening lectures: (1) "Pentose Phosphate Metabolism" by Dr. D. P. Burma of the Bose Research Institute, Calcutta, (2) "Purification of Enzymes" by Dr. B. K. Bachhav of the Christian Medical College, Vellore; (3) "Protein Synthesis" by Dr. P. M. Bhargava of the Regional Research Laboratory, Hyderabad, and (4) "Coenzyme Q" by Dr. T. Ramasarma of the Indian Institute of Science, Bangalore.

Over 60 original papers were presented by the delegates and members of the respective departments. The symposium on "Biology and Biochemistry of Micro-organisms" was divided into three sections—General Microbiology, Industrial and Agricultural Microbiology and Metabolism of micro-organisms. Some of the high-lights of the papers presented in these three sections were: the discovery for the first time the nucleus and vacuole in the living cell of yeast, the production of bacterial diastase and protease for desizing, leather bating and cheese making and the synthesis of proteins and itaconic acid in bacteria. The papers under "Enzymes" included the purification of certain vital enzymes from the brain and from plants and the induction of enzymes in the rice moth larvæ which throw light on the fundamental biochemical problems. Under "Vitamins" among other papers, the action of vitamin A in vision, the possible role of certain anti-vitamins in cancer cure in experimental animals, and the evaluation of vitamins in human milk were discussed.

LETTERS TO THE EDITOR

THE NUCLEAR SCATTERING OF 970 Mev. PROTONS BY CARBON

RECENTLY experimental observations on the differential scattering cross-sections and nucleonic polarization for the elastic scattering of 970 Mev. protons by carbon have been obtained by Batty and Goldsack.¹ It is reasonable to assume that the first Born approximation is valid for the nuclear scattering of such high energy protons by light nuclei and the observed polarization. Following Malenka,² the total nuclear potential may be written as

$$U(\vec{r}) = U_0(r) + U_p(r) \frac{1}{2} \vec{\sigma} \cdot (\vec{r} \times \vec{k}) \quad (1)$$

where

$$U_0(r) = -2k\bar{n}\rho(r), \quad U_p(r) = -2k\bar{n}_1\rho_p(r),$$

while $\vec{k} = -i\nabla$ and $\vec{\sigma}$ is the usual Pauli Spin Operator. Assuming the distribution $\rho_p(r) = \alpha\rho(r)$

where α is a constant and $\bar{n} = \bar{n}_1 + i\bar{n}_2$, we have for a characteristic nuclear density distribution

$$U(\vec{r}) = -2k\rho(\vec{r}) \left\{ \bar{n} + \frac{\alpha}{2} \bar{n}_1 \vec{\sigma} \cdot (\vec{r} \times \vec{k}) \right\} \quad (2)$$

where $\vec{k} = \vec{k} \times A^{1/3}$ and $\vec{r} = \vec{r} \times A^{-1/3}$. The expressions for the scattering cross-section $\sigma(\vec{S})$ and the polarization function $P(\vec{S})$ in the above approximation are given by the relations

$$\sigma(\vec{S}) = 4k^2 A^2 \left[|\bar{n}|^2 h^2 + \frac{k^2 (\bar{n}_1 \alpha)^2}{4} h'^2 \right] \quad (3)$$

$$P(\vec{S}) = - \frac{k (\bar{n}_1 \alpha) \bar{n}_2 h h'}{|\bar{n}|^2 h^2 + \frac{k^2 \bar{n}_1^2 \alpha^2}{4} h'^2} \quad (4)$$

where

$$h = \frac{1}{\bar{S}} \int_0^\infty \rho(\vec{r}) \sin(\vec{S} \cdot \vec{r}) \vec{r} d\vec{r}$$

and

$$h' = \frac{d}{d\bar{S}} [h]$$

with

$$\vec{\alpha} = \alpha \times A^{1/3}, \quad \vec{S} = \vec{S} \times A^{1/3} \text{ and } S = 2k \sin(\theta/2).$$

A characteristic nuclear density distribution $\rho(\vec{r})$ for light elements has been obtained by Gatha, Shah and Patel³ from an analysis of the experimental data on the nuclear scattering of 340 Mev. protons. Subsequently, Gatha and

Shah⁴ have obtained from the same data a revised characteristic nuclear density distribution given by

$$\rho(\vec{r}) = a_1 \exp(-b_1 \vec{r}^2) + a_2 \exp(-b_2 \vec{r}^2) \times \{1 - b_3 \vec{r}^2 + b_4 \vec{r}^4\} \quad (5)$$

where

$$\begin{aligned} a_1 &= 0.12 \times 10^{39} \text{ cm.}^{-3}, & a_2 &= 0.25 \times 10^{39} \text{ cm.}^{-3}, \\ b_1 &= 8.62 \times 10^{26} \text{ cm.}^{-2}, & b_2 &= 1.09 \times 10^{26} \text{ cm.}^{-2}, \\ b_3 &= 0.44 \times 10^{26} \text{ cm.}^{-2}, & b_4 &= 0.13 \times 10^{52} \text{ cm.}^{-4}. \end{aligned}$$

In the present investigation h and h' have been calculated using equation (5). The value of \bar{n}_2 has been taken equal to 19.5 mbn. from the experimental observations of the scattering cross-sections for the (n, n) and (n, p) scattering respectively. The value of \bar{n}_1 as given by Jastrow's⁵ model for nucleon-nucleon interaction will be vanishingly small at such a high energy.

Therefore, $\bar{n} \simeq \bar{n}_2 = 19.5 \text{ mbn.}$ We have also found that $\bar{n}_1 \alpha = 1 \text{ mbn.}$ gives the best agreement between the theoretical and the experimental value of $P(\vec{S})$.

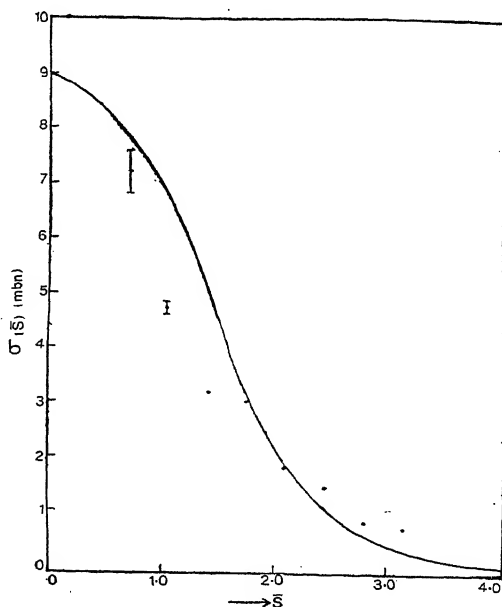


FIG. 1. Diffraction pattern for the nuclear scattering of 970 Mev. protons by carbon.

The theoretical $\sigma(\bar{S})$ and $P(\bar{S})$ have been calculated from equations (3) and (4) and are plotted against (\bar{S}) in Figs. 1 and 2 respectively. The experimental values of $\sigma(\bar{S})$ and $P(\bar{S})$ as obtained by Batty and Goldsack¹ have also been plotted together with their probable errors in Figs. 1 and 2. It is clear that there is an approximate fit between the theoretical and the experimental values of $\sigma(\bar{S})$, while there is a reasonable agreement between the theoretical and the experimental values of $P(\bar{S})$. It may be noted that the errors shown in Fig. 1 are statistical only and the absolute values of the cross-section may be in error by $\pm 50\%$ owing to poor beam monitoring.

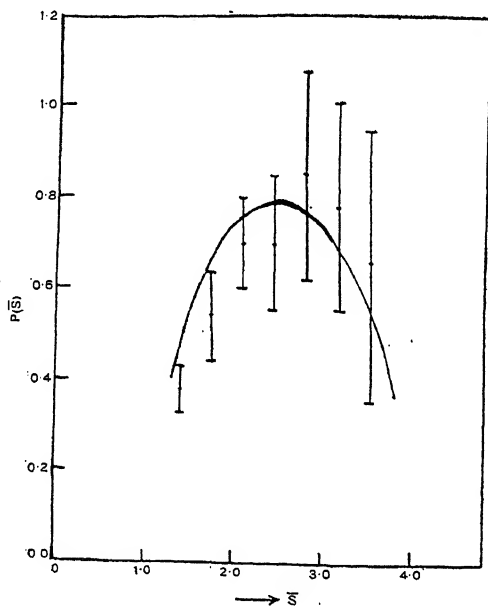


FIG. 2. The nucleonic polarization $P(\bar{S})$ as a function of \bar{S} for 970 Mev. protons scattered by carbon.

Therefore, it can be concluded that the above complex nuclear potential, based upon the above characteristic nuclear density distribution, can approximately correlate the experimental data on the nuclear scattering and polarization of 970 Mev. protons by carbon. However, the deviations from the general trend may perhaps be due to the approximate nature of the concept of a characteristic nuclear density distribution.

Bhavan's College,
Andheri, Bombay-41,
and

Institute of Science,
Mayo Road, Bombay-1,
June 1, 1959.

G. Z. SHAH.

K. M. GATHA.

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PORTABLE THERMISTER THERMOMETER FOR ESTUARINE INVESTIGATION

THE standard methods for the measurement of temperatures in the sea is by the use of Bathy-thermograph or by special reversing thermometers. Both these instruments can be usefully employed in deeper sea and are not suited for measurements in shallow water channels for hydrologic studies. The reversing thermometers are useful only at preset depths and can give spot measurements at only one or two points in shallow channels while the grid of the Bathy-thermograph would not show any readable accuracy for temperature measurements if used for this purpose. It was, therefore, felt necessary to develop a portable thermister thermometer which could be used for continuous measurements of temperatures for hydrologic studies in estuaries 50 to 100 feet deep.

A thermister type F 2311/300 with a negative temperature coefficient was selected as the temperature measuring element. It was mounted inside a perspex tube provided with two water-tight stoppers at one end and the other was open with a number of holes on the sides. The perspex tube was mounted on a suitable frame of sufficient weight to carry the probe down vertically. A two-core water-tight cable connected the thermister and was run along the steel rope which lowered the frame from a winch or a derrick from on board the ship. It could also be lowered from small boats. 100 feet of cable has been provided with the probe for measuring temperatures. The depth is measured by the length of the steel-rope paid out from the winch.

The thermister with the cable forms part of a Wheatstone Bridge of the type used by McLean.¹ It is particularly useful for the study of microthermal structure of sea-water as the size and thermal capacity of the thermister bead is very small. The Bridge can be easily balanced with a thermister of good stability² for initial surface temperature of the sea-water when the galvanometer reads null. A small variation of temperature then produces

an out-of-balance current in the bridge which is measured on a micrometer. A sensitivity of $2.2 \mu\text{A}/^\circ\text{C}$. has been obtained in the range 25° to 35°C .

This thermometer has been used to measure temperature variations in the Ernakulam channel up to a depth of 30 ft. (Fig. 1). It can

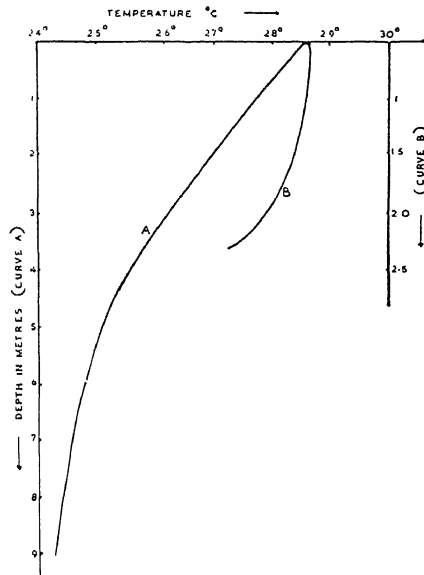


FIG. 1

also be used for measuring air temperature in the first 100 feet above ground for super-refraction work. It can be used with a D.C. amplifier to study microthermal structures of sea layers in open seas, which are responsible for wide fluctuations of sound intensities in Asdic work.

One of the authors (V.S.R.) is thankful to the Ministry of Education and Cultural Affairs, for the grant of a stipend.

Indian Naval Phys. Lab., S. S. SRIVASTAVA.
Cochin, K. V. S. RAMAM.
April 10, 1959.

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OXIDATION OF XYLENES IN THE FLUIDISED BED

BHATTACHARYYA AND GULATI¹ have recently reported the results of their interesting and important investigations on the vapour phase oxidation of xylenes in the static bed using large number of catalyst compositions containing vanadium, molybdenum, tungsten, uranium, etc., under various experimental conditions. They found that vanadium containing catalysts

were superior to other catalysts. Fused vanadium pentoxide was found to have the maximum catalytic activity among the various vanadium oxide catalysts studied—fused and unfused, promoted and unpromoted; supported and unsupported. Using the fused catalyst the maximum conversion of *o*-xylene to phthalic anhydride was 61.73% and the selectivity was 86.6% at a temperature of 490°C . air/xylene ratio of 275 and space velocity of 5750.

During the oxidation of xylenes, *ortho*, *meta* and *para*, considerable amount of heat is liberated. Anticipating that these reactions, if carried out under practically isothermal conditions, might lead to improved yield and higher selectivity, they have been studied under fluidised bed with various vanadium oxide catalysts.

The vapour phase oxidation of orthoxylene has been studied in the fluidised bed with vanadium pentoxide catalyst—fused, fused with different proportions of pumice support and unfused supported and promoted catalysts under wide ranges of temperature, air/xylene ratio, space velocity, volume of the catalyst, and concentration of CO_2 in the feed. The products obtained using fused catalysts were mainly phthalic anhydride, *o*-toluic aldehyde and carbon dioxide and traces of quinone whilst in the case of static bed maleic anhydride was present instead of *o*-toluic aldehyde. In the case of unfused catalyst in fluidised bed all the above products were found. Fused vanadium pentoxide gave the maximum yield of phthalic anhydride with high selectivity. Under conditions; [490°C ., air/xylene ratio = 95.1; space velocity = 10,030; volume of the catalyst = 17.3 c.c. (equivalent to 20 gm.)] at which maximum conversion to phthalic anhydride was obtained, over the experimental runs given by the authors, the conversion to phthalic anhydride was 67.8% and that to *o*-toluic aldehyde was 3.56% leading to a selectivity of 95%. One interesting feature with fused vanadium pentoxide catalyst in the oxidation of *o*-xylene under fluidised condition was that the yield of phthalic anhydride increased (with increase in concentration of xylene) when the air/xylene ratio was decreased from 2,230 to 102.5 and again fell down when the air/xylene ratio was further decreased to 53.9. Aldehyde yield fell down considerably when air/xylene ratio was reduced. This effect is the reverse of that observed previously in the static bed.²

Similar studies were made with other catalysts and their behaviour was found to be different.

In the case of fluidised bed with fused V_2O_5 under conditions (465°C . air/xylene ratio = 365; space velocity = 9,550) at which maximum conversion to terephthalaldehydic acid and terephthalaldehyde was obtained, over the experimental runs given by the authors, *p*-xylene was converted to the following partial oxidation products to the extent given below:

Terephthalaldehydic acid = 3.12%; terephthalaldehyde = 19.32%; *p*-toluic acid = 2.05%; *p*-toluic aldehyde = 19.91%; maleic anhydride = 20.17%; quinone = 5.18%. In the static bed terephthalic acid was present whilst terephthalaldehyde and terephthalaldehydic acid were absent.

In the case of fluidised bed with fused V_2O_5 under conditions (540°C .; air/xylene ratio = 121.5; space velocity = 9,300), at which maximum conversion to maleic anhydride was obtained, over the experimental runs given by the authors, the *meta*-xylene was converted to the following partial oxidation products to the extent given below: maleic anhydride = 32.68%; *m*-toluic aldehyde = 10.82%; quinone = 0.51%. In the static bed in addition to the above products isophthalic acid was present in traces.

Dept. of Applied Chemistry,
Indian Institute of Technology,
Kharagpur,
May 29, 1959.

S. K. BHATTACHARYYA.

R. KRISHNAMURTHY.

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THE PREPARATION OF URANIUM DIOXIDE FROM URANIUM (IV) OXYFORMATE

URANIUM dioxide is generally prepared by the reduction of UO_3 or U_3O_8 with hydrogen¹ or by the action of water vapour on metallic uranium or its hydride² at high temperature. With a view to obtain uranium dioxide by a simple and convenient method at a comparatively low temperature the thermal decomposition of uranium (IV) oxyformate,³ oxyacetate, tetraacetate,⁴ oxyoxalate and oxalate⁵ obtained by photolysis using sunlight was undertaken by the authors. Of these the thermal decomposition of anhydrous oxyformate proved to be the most promising. When UO_2 is heated in air, it is converted to U_3O_8 and thus there is gain in weight. This gain in weight method of analysis has been applied for the determination of uranium dioxide content of

the residue obtained by heating the anhydrous uranium (IV) oxyformate, in vacuum to dull red heat. The data recorded in Table I show that about 90% of the residue is uranium dioxide, the remaining 10% being U_3O_8 .

TABLE I
Analysis of the residue after heating in vacuum
to dull red heat
Weight in mg.

Amount of residue	Gain in weight	UO_2 calculated from gain in weight	Percentage of UO_2 in the residue
579.5	21.0	531.6	91.6
674.8	24.0	607.5	90.0

The precise thermo-gravimetric analysis of the compound, which was not possible on account of the want of a thermobalance, in the opinion of the authors, may produce better results and would thus facilitate the preparation of a compound so greatly needed.

Department of Chemistry, BALARAM SAHOO.
Ravenshaw College, D. PATNAIK.
Utkal University,
Cuttack, March 30, 1959.

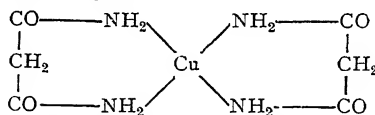
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POLAROGRAPHIC STUDY OF THE BIURET-REACTION OF MALONAMIDE

In continuation of our polarographic studies on biuret-reaction,¹ interaction of malonamide with copper sulphate was taken up. Malonamide, a white crystalline product, m.p. 170°C ., was obtained by recrystallising from water the product of the reaction of liquor ammonia on malonic ester. 1.0 M solution of the amide was prepared in doubly distilled water and was diluted with phosphate buffer in order to get the requisite concentrations (0.20 M, 0.15 M, 0.10 M, 0.08 M, 0.04 M). Copper sulphate solution of 1.0 millimolar concentration was used and was obtained by diluting 0.50 c.c. of 0.02 M solution to 10 c.c. by phosphate buffer containing amide of different concentrations. These buffers also acted as supporting electrolytes. Solutions, of pH 11.0, 11.4, 11.6, 11.8,

12.0, obtained by mixing 0.15 M disodium hydrogen phosphate and 0.1 M sodium hydroxide in varying proportions, were used in these experiments.² Polarograms were taken with the help of Fisher Electropode in conjunction with a multiflex galvanometer type MGF₂. Methyl red solution of concentration 0.001% was used as the maximum suppressor. All experiments were carried out at $35 \pm 0.1^\circ \text{C}$. In all thirty polarograms, using a dropping mercury cathode in an inert atmosphere of nitrogen, were studied. Typical curves are shown in Fig. 1.

On this basis the structural formula of the complex may be given as:



Unlike copper-biuret and copper-serine complexes no linear and regular relationship was obtained on plotting $E_{1/2}$ against pH although $E_{1/2}$ values showed a decrease with decrease in pH. The behaviour of the diffusion current was also found to be different. Here the value of the diffusion current was quite different at pH 11.0 and 11.4. A negative deviation from more or less constant values for pH 11.6, 11.8 and 12.0 was observed. This might be due to the decrease in the complexing tendency of malonamide at pH 11.0 and 11.4. Mention may be made of the fact that at pH 11.0 a slight green turbidity was observable.

Further work on the polarography of amides and amino-acid complexes is in progress.

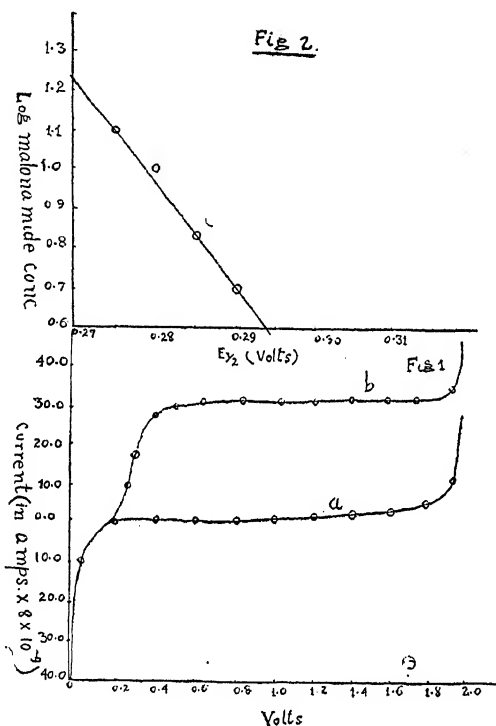
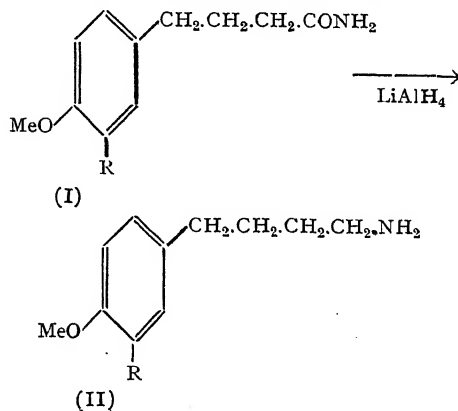
Dept. of Chemistry,
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Aligarh, June 22, 1959.

A. AZIZKHAN.
WAHID U. MALIK.

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SYNTHESIS OF δ -(3-ALKYL-4-METHOXYPHENYL)-*n*-BUTYLAMINES

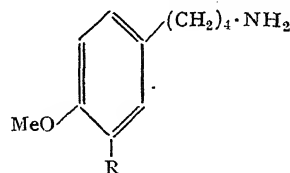
A FEW β -(3-alkyl-4-methoxyphenyl)-ethylamines and γ -(3-alkyl-4-methoxyphenyl)-propylamines were synthesised¹ with a view to testing them for amoebicidal activity. If in the latter type, the amino group is further removed from the nucleus by one more C-atom it will lead to the compounds of the type δ -(3-alkyl-4-methoxyphenyl)-*n*-butylamine (II). It has



- a. Polarogram of supporting-electrolyte.
b. Polarogram of 1.0 millimolar Copper Sulphate in 0.20 M malonamide.

From the polarograms it could be concluded that copper-complex of malonamide is reducible reversibly at the dropping mercury electrode. The reversibility of the electrode reaction was tested by Tómes method.³ The difference of $E_{3/4}$ and $E_{1/4}$ was found to be 0.065 showing thereby that the reaction proceeds with one electron transfer. Plots of $E_{1/2}$ vs.-log. concn. of malonamide (vide Fig. 2) gave a straight line with a slope of 0.035. This goes to prove that two molecules of amide take part in the complex formation with one atom of copper.

TABLE I

 δ -(3-Alkyl-4-methoxyphenyl)-*n*-butylamine (II)

R =	Cryst. from	m.p.	% yield	Hydrochloride Formula	Found %N	Calc.	Picrate Cryst. from	m.p.
1 CH ₃	.. Ethyl acetate + abs. alc.	184°	60	C ₁₂ H ₂₀ NOCl	6.3	6.1	dil. alc.	118°
2 C ₂ H ₅	.. do.	149°	60	C ₁₃ H ₂₂ NOCl	5.78	5.74	do.	105°
3 <i>n</i> -C ₃ H ₇	.. do.	150°	63	C ₁₄ H ₂₄ NOCl	5.56	5.43	do.	100°
4 <i>n</i> -C ₄ H ₉	.. Ethyl acetate	133°	64	C ₁₅ H ₂₆ NOCl	5.21	5.15	do.	104°

been considered worthwhile to synthesise these and to examine their amœbicidal activity.

δ -(3-Alkyl-4-methoxyphenyl)-*n*-butylamines have been obtained by the reduction of appropriate γ -(3-alkyl-4-methoxyphenyl)-*n*-butyramides (I) with LiAlH₄ in dry ether. The amines were directly isolated as hydrochlorides from the ethereal solution. The synthesis of the amides (I, R = Me, Et, *n*-Pr) has already been described¹ whereas the amide (I, R = *n*-Bu) was obtained from *o*-*n*-butylanisole by condensing the latter with succinic anhydride in nitrobenzene in the presence of anhydrous aluminium chloride to yield β -(3-*n*-butyl-4-methoxybenzoyl)-propionic acid (yield 62%, cryst. from dil. alc., m.p. 130°. Found: C, 68.05; H, 7.73. C₁₅H₂₀O₄ requires C, 68.18; H, 7.57%) which by Clemmenson reduction in toluene solution reduced to γ -(3-*n*-butyl-4-methoxyphenyl)-*n*-butyric acid (yield 55%, b.p. 240-45°/13 mm. Found: C, 71.84; H, 8.7. C₁₅H₂₂O₃ requires C, 72.0; H, 8.8%) and subsequent conversion to γ -(3-*n*-butyl-4-methoxyphenyl)-*n*-butyramide (yield 83%, cryst. from dil. alc., m.p. 92°, Found: N, 5.74. C₁₅H₂₃O₂N requires N, 5.62%).

The various constants of the amines (II) are given in Table I.

The authors acknowledge their thanks to Dr. Mata Prasad, Vice-Chancellor, Vikram University, for providing research facilities.

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School of Studies (Chemistry),
Vikram University,
Ujjain (M.P.), March 19, 1959.

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CAFFEINE AND TANNIN CONTENT OF STALKY TEA

UNDER the *Prevention of Food Adulteration Rules*,¹ no distinction has been made between dust, leafy and stalky tea in the standard. Only the crude fibre content has been fixed as, "not more than 15%". Stalky tea having high stalk contents is found to pass the prescribed standard of crude fibre. Considering that the flavour of tea largely depends,² on its caffeine and tannin values it would be interesting to find out if any correlation exists between the crude fibre contents and the caffeine and tannin values of stalky tea.

Fifty samples of tea were analysed for crude fibre, caffeine and tannin values. Crude fibre was estimated by standard method,³ by digesting 2 g. tea, first with 200 ml., 1.25% sulphuric acid for 30 minutes, then with 1.25% sodium hydroxide. It was washed with 100 ml., 1% hydrochloric acid and again with alcohol in ether, and dried to constant weight. Caffeine was estimated by the Bailey and Andre method,⁴ by boiling tea with heavy magnesium, extracting with chloroform and finally drying to constant weight. Tannin was estimated by A.O.A.C. method,⁵ by process of oxidation with potassium permanganate.

TABLE I

Group	Number of samples	Crude fibre range of values	Caffeine range of values	Tannin range of values
A	.. 10	5.0-10.1	2.1-2.8	7.0-9.6
B	.. 10	10.3-15.0	2.0-2.7	7.0-8.2
C	.. 15	15.2-20.0	2.5-3.0	6.1-8.8
D	.. 15	20.4-30.4	2.0-2.8	5.2-8.0

The results given in Table I show that there is no correlation between crude fibre contents and caffeine and tannin values of stalky tea. In general, caffeine and tannin values of stalky tea are found low. Also it appears that there is no possibility of incorporating caffeine and tannin contents in the standard, in assessing the purity of stalky tea.

Public Health Lab., SATYA RANJAN SARKAR.
Darjeeling,
April 8, 1959.

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SOME STYRYL DERIVATIVES OF 4 (3)-QUINAZOLONES AS POTENTIAL FILARICIDES

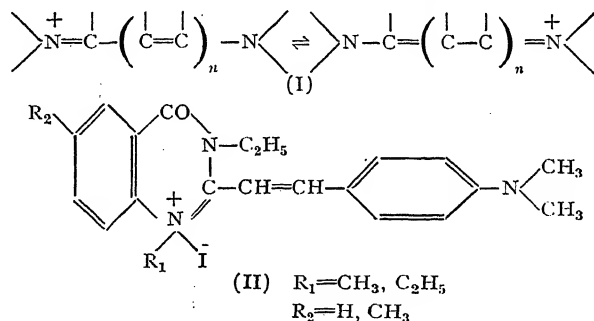
A LARGE number of cyanine dyes and related styryl derivatives have been successfully investigated as filaricides.¹⁻⁵ Amongst these 1'-Ethyl-3 : 6-dimethyl-2-phenyl-4-pyrimido-2'-cyanine chloride was highly active against adult filarial worms in cotton rats although against *W. bancrofti*, the results were less promising. Similarly, 2-p-di-iso-propylamino-styryl-6-methyl-quinoline-methochloride⁴ was found to be the most active amongst several styryl-quinoline derivatives tested.^{4,5} Antifilarial activity in above cases was not restricted to any particular type

methyl-3-ethyl-6-substituted-4 (3)-quinazolone derivatives were synthesised by condensing appropriate acetantranils with ethylamine in ethanolic medium.^{7,8} Alkyl iodides of these 4 (3)-quinazolone derivatives were prepared by heating them with methyl or ethyl iodide in a sealed tube at 110-20° C. for 5-6 hours.⁹ Finally, equimolar quantities of 2-methyl-3-ethyl-6-substituted-4 (3)-quinazolone alkyl iodides were condensed with p-dimethyl-amino-benzaldehyde in presence of acetic anhydride¹⁰ and the final products crystallised from absolute methanol as red dyes. The following have been synthesised:—

- (a) 2-p-Dimethylamino-styryl-3-ethyl-4 (2)-quinazolone-ethyl iodide; orange-red needles, m.p. 212° C. (Found N, 8.83; $C_{28}H_{26}ON_3I$ requires N, 8.84%).
- (b) 2-p-Dimethylamino-styryl-3-ethyl-6-methyl-4 (3)-quinazolone, methyl iodide; purple-red needles, m.p. 258-60° C. (Found N, 9.07, $C_{22}H_{30}ON_3I$ required N, 8.84%).
- (b) 2-p-Dimethylamino-styryl-3-ethyl-6-methyl-4 (3)-quinazolone-ethyl iodide; orange-red granules, m.p. 218° C. (Ultra-violet absorption H_2O Max. 225 m μ) (Found N, 8.81, $C_{23}H_{28}ON_3I$ requires N, 8.59%).

Further work is in progress.
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of ring structure but was basically associated with the presence of an amidinium ion system (I), in which a positively charged quaternary nitrogen was linked to a tertiary nitrogen by a conjugated chain of at least three carbons in length.⁶

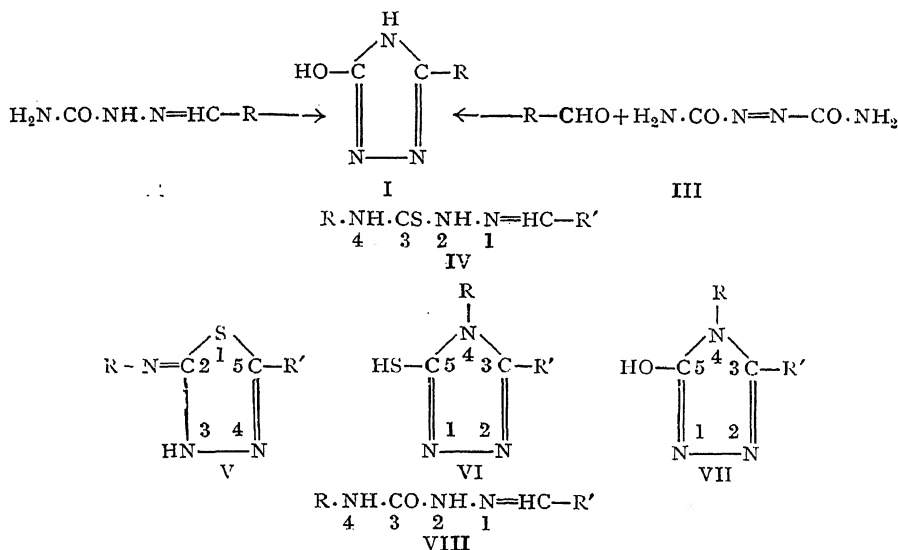
In view of the above hypothesis, some 2-p-dimethyl-aminostyryl-3-ethyl-6-substituted-4 (3)-quinazolone-alkyl iodides (II) have now been synthesised as potential filaricides. Firstly, 2-

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AN IMPROVED OXIDATION PROCEDURE FOR THE PREPARATION OF 5-HYDROXY-4, 1, 2-TRIAZOLES

SUITABLY substituted 4, 1, 2-triazoles have been reported to possess interesting physiological properties.¹⁻³ 5-Hydroxy-4, 1, 2-triazoles (I), present in addition interesting structural problems. Methods available hitherto for the synthesis of these triazoles involve the heating of aldehyde semicarbazones (II) with an alcoholic solution of ferric chloride in a sealed tube,⁴ or the treatment of aldehydes and azodicarbamides (III) with ferrous chloride likewise,⁴ both procedures being cumbersome.



During the course of a detailed study on the reactivity of thiosemicarbazones (IV), we had occasion to note that 4-aryl thiosemicarbazones on oxidation with potassium ferricyanide and alkali yielded, in addition to the reported 2-arylimino-5-aryl- Δ^4 -1, 3, 4-thiodiazolines (V),⁵ small quantities of higher melting, alkali-soluble substances in some cases. On the basis of the earlier observations of Young and Eyre,⁶ it was first suspected that these products may be 5-mercapto-3, 4-diaryl-4, 1, 2-triazoles (VI). However, the absence of sulphur and their analytical data indicated them to be 5-hydroxy-3, 4-diaryl-4, 1, 2-triazoles (VII),

arising from the thiosemicarbazones (IV) by desulphurisation caused by alkaline ferricyanide.

The product obtained by the acidification of the filtrate from the oxidation of 1-benzal-4-phenyl thiosemicarbazone with potassium ferricyanide and alkali was found to be identical with 5-hydroxy-3, 4-diphenyl-4, 1, 2-triazole (VII; R and R' = phenyl), prepared by heating 1-benzal-4-phenyl semicarbazone (VIII; R and R' = phenyl) with ferric chloride in a sealed tube at 130° C. for one hour.^{7,8}

This incidental observation led to the interesting finding that 4-aryl semicarbazones (VIII), the sulphur-free analogues of 4-aryl thiosemicarbazones, could be smoothly and readily converted in high yields by heating with potassium ferricyanide and alkali on a water-bath for about an hour, to 5-hydroxy-3, 4-diaryl-4, 1, 2-triazoles. Compared with the previously available methods, the present one appears to be superior, proceeding to completion at ordinary temperatures, with high yields of uncon-

taminated products. The results obtained in a typical set of experiments are summarised in Table I.

TABLE I

Semicarbazone oxidised (VIII)		Hydroxy triazole obtained (VII)	
R	R'	% yield	Melting point °C.
1 Phenyl	.. Phenyl	96	256*
2 do.	.. <i>p</i> -Methoxyphenyl	94	240
3 do.	.. <i>m</i> -Nitrophenyl	91	219
4 <i>p</i> -Tolyl	.. Phenyl	72	244
5 do.	.. <i>p</i> -Methoxyphenyl	81	216
6 do.	.. <i>m</i> -Nitrophenyl	74	251

* Compound reported in literature 7, 8.

Extension of this reaction to a variety of semicarbazones has also been achieved. Full details will be published elsewhere.

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THYROID GLAND IN OPHICEPHALIDAE (ACTINOPTERYGII, PERCOMORPHI)

In *Ophicephalus striatus* a new structure has been described by Das and Saxena,^{1,2} lying on the floor of the anterior region of the pharynx and surrounding the ventral aorta along most of its length. They named it as 'subpharyngeal sinus'. According to these authors the 'sub-pharyngeal sinus' is a venous sinus and part of the blood vascular system of the fish. The 'sub-pharyngeal sinus' of Das and Saxena is in reality the thyroid gland of the fish.

In Ophicephalidae the thyroid gland is a compact structure and is enclosed by a thin capsular wall of connective tissue, unlike that in the majority of teleost fishes where follicles are unencapsulated and dispersed individually or in clusters around the roots of afferent branchial arteries. It has been described³ in a number of fishes, viz., *Galeichthys felis*, *Gymnarchus niloticus*, *Thynnus thynnus* and several members of the family Sparidae.

Sections of *O. striatus* through the region of ventral aorta (Fig. 1) show the thyroid gland

surrounding the ventral aorta. It is seen to consist of thyroid follicles and blood capillaries. A similar condition is noticed in *O. punctatus* and *O. gachua*.

The presence of a compact thyroid gland in Ophicephalidae might be associated with the air breathing habit. It is quite possible that the thyroid gland acts here as a thermoregulator in order to adapt the fish to a semi-terrestrial environment of low thermal capacity.

The detailed structure and physiology of this gland in *Ophicephalus* will be published elsewhere by one of the authors (Belsare, D. K.).

The authors are grateful to Prof. D. S. Srivastava for research facilities and encouragement.

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MICRONUCLEAR VARIATION IN RACES OF BLEPHARISMA UNDULANS STEIN

Blepharisma undulans is apparently of wide distribution and occurs in the form of a number of races. Suzuki¹ on the basis of macronuclear characters has identified three races, *B.u. americanus*, *B.u. japonicus* and *B.u. undulans*. Recent collections from India have shown that we have in this country animals which belong to two more races. Due to the courtesy of Dr. A. C. Giese and Dr. S. Suzuki we have now in our laboratory all the five races of *B. undulans*, the three described by Suzuki as well as two local ones. An examination of these has convinced us that these five races are quite distinct from one another and differ in a number of characters like size, peristome length, macronuclear form, amount of pigment and its reactions as well as details of life-history.²⁻⁵ We are engaged in this laboratory on comparative studies of the various aspects of these animals.

It is perhaps worth while to make a brief report here of the micronuclei in these five races. We found them as small circular bodies close to the macronucleus in the cytoplasm. The number varies from 8 to 20 in all the races except in *B.u. undulans*, where they tend to be fewer. We have rarely come across a specimen

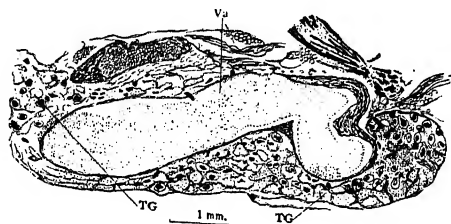
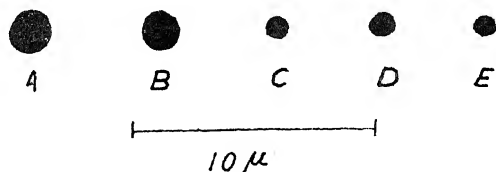


FIG. 1. Camera lucida sketch of the ventral aorta (Va) and the thyroid gland (TG) of *Ophicephalus striatus*, in longitudinal vertical section.

belonging to this race with more than six micronuclei. But it is the size of micronucleus that is of special interest. Figure 1 shows the outlines



of micronuclei of the five races. A and B are Indian races, C is *B.u. americanus*, D is *B.u. japonicus* and E is *B.u. undulans*. The micronuclear size in Indian races is apparently very large as compared with European, Japanese and American forms. While the significance of this difference is being investigated, the micronucleus forms an additional diagnostic feature of the races *B. undulans*.

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CHROMOSOME COMPLEMENT AND MEIOSIS IN AN ELATERID BEETLE, *AGRYPNUS FUSCIPES* FABRICIUS (COLEOPTERA: ELATERIDAE)

MEIOSIS in the members of the family Elateridae of the insect order Coleoptera has been reported earlier by Stevens^{1,2} and recently by Smith.³ While listing the chromosome number and sex determining mechanisms in nearly 340 species of Coleoptera belonging to different families and subfamilies, Smith⁴ has also referred to 35 species of Elateridae. All these species belong to the subfamilies Pyrophorinae, Elaterinae and Cardiophorinae. As for the Indian Coleoptera the information is very meagre. Asana *et al.*⁵ and Bose⁶ have recorded a few species.

The material *Agrypnus fuscipes* Fabricius, belonging to the family Elateridae, was collected from Ballygunge, Calcutta, in June 1958. Testes, dissected out from living males, were prepared according to the aceto-carmine squash method.

Sections (10 μ) stained in Feulgen's stain were also examined.



Figures have been drawn with the help of a camera lucida at a magnification of $\times 1,560$. FIG. 1. Spermatogonial metaphase stage. FIG. 2. Early prophase stage showing the heteropycnotic sex chromosome. FIG. 3. Diakinesis stage. FIG. 4. Metaphase I with the bent and faintly stained X chromosome (polar view). FIG. 5. Metaphase II with the bent X chromosome (side view). FIG. 6. Metaphase I showing the X chromosome located ahead of the autosomes. FIG. 7. Anaphase I. FIG. 8. Telophase I with the lagging X chromosome. FIG. 9. Metaphase II with eight chromosomes. FIG. 10. Metaphase II with nine chromosomes.

Spermatogonia.—Seventeen chromosomes are present in the spermatogonial metaphase stage. The chromosomes can be classified as six large, ten medium and one small (Fig. 1). The smallest element is the single X chromosome. All the chromosomes at this stage appear spherical in shape. The elements at this stage are so condensed that the position of the centromere remains obscure. The nature

of the spermatocyte chromosomes, however, suggests that they are all acrocentric.

Meiosis:—In the early prophase stages of the spermatocyte division the sex chromosome is seen as a deeply stained body usually located near the nuclear membrane (Fig. 2). At diplotene the bivalents have usually a single chiasma. The sex chromosome at this stage is a little more deeply stained than the autosomal bivalents. At diakinesis all the eight bivalents and the single X chromosome stain with equal intensity. The chiasma frequency at this stage is very low (Fig. 3). At metaphase of the primary spermatocyte division nine chromosomes are present. The sex chromosome generally lies at the centre of the spindle surrounded by the autosomes. Some bivalents at this stage exhibit interstitial chiasma. The X chromosome at this stage stains very poorly. It appears that the X chromosome exhibits a gradual decondensation as the spermatocyte stages proceed. This process actually starts at diakinesis. Moreover, the sex chromosome is bent like a hook at one end. Both the autosomes and the sex chromosomes orientate on the equator lying parallel to the axis. The sex chromosome is generally placed a little ahead of the autosomes towards one of the poles (Figs. 4, 5 and 6). The sex chromosome and the autosomes segregate at anaphase I, undivided to the poles, thereby one pole is with the X chromosome and the other without it (Fig. 7). In several anaphase cells the sex chromosome is found lagging on the spindle. Thus, it is very interesting to note that the X chromosome which initially started with a precocious movement ultimately becomes the last element to reach the pole (Fig. 8). As a result of prereduction of the X chromosome at anaphase I, two types of metaphase II cells are formed and they are with nine and eight chromosomes, the former type is with the single X chromosome (Figs. 9 and 10). Anaphase II is simple and typically mitotic. Two types of secondary telophase nuclei, thus formed are, one with the sex chromosome, and the other devoid of it. The male determining sperms have eight chromosomes and the female determining sperms are with nine chromosomes.

This work has been done under the supervision of Dr. S. P. Ray-Chaudhuri. The author also expresses his thanks to Dr. A. P. Kapur, Zoological Survey of India, Calcutta, for kindly identifying the material used here.

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OCCURRENCE OF *GLANDICEPS* SP. AND *SACCOGLOSSUS* SP. (ENTEROPNEUSTA) FROM THE INSHORE WATERS AT PORTO NOVO

MENON¹ recorded the occurrence of *Glandiceps coramandelicus* Spengel and *Saccoglossus bournei* Menon from Madras. Rao² described a second species, *Glandiceps stiasnyi* Rao, from young worms obtained by rearing *Tornaria*. Rao³ further reported the occurrence of *Saccoglossus madrasensis* Rao, *Glossobalanus minutus* Kowalevsky and five varieties of *Ptychodera flava* Eschscholtz from Madras and the Gulf of Mannar.

Tornaria larvae are commonly present in the plankton during January to March in the inshore waters at Porto Novo and also in the Marine Zone of the Vellar estuary, but the occurrence of the adults in these regions was not known till recently. The Marine Biological Station, Porto Novo, has been conducting regular cruises on the inshore waters of the Bay of Bengal. During one of these cruises in March this year, a single young live specimen of Enteropneusta, provisionally identified as *Glandiceps* sp., was dredged at 10 fathoms, about four miles from the shore. Again more recently another single specimen of Enteropneusta identified as *Saccoglossus* sp. was dredged at another station, also at 10 fathoms. The overall length of this specimen was 10.6 mm., the proboscis alone measuring 5.6 mm. A systematic search is in progress to determine the area of distribution of these species.

Glandiceps sp. occurs in a region where the bottom sediment consists of about 56% clay and silt, 11% very fine sand, 16% fine sand, 9% medium sand, 7% coarse sand and nearly 1% very coarse sand, and *Saccoglossus* sp. in a substratum composed of 39% silt and clay, 10% very fine sand, 8% fine sand, 12% medium sand, 18% coarse sand and 13% very coarse sand.

Further investigations are in progress and a detailed account will be published elsewhere.

My thanks are due to Prof. R. V. Seshaiya, Director, Marine Biological Station, Porto Novo, and to the other Officers of the Station for help

and encouragement and to the Government of India for a Senior Research Scholarship.

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HERITABILITY AND REPEATABILITY OF MILK YIELD IN MALVI CATTLE

ESTIMATES of heritability for milk yield in European cattle have been recorded by Laben *et al.* (1950)² and Randel *et al.* (1957)³ Amongst the Indian cattle similar values for Harijana breed have been reported (Krishnam, 1956).¹ There is, however, no record of similar estimate of heritability of milk yield for Malvi cattle.

Data on milk yield of 1st and 2nd lactations of 44 daughter-dam pairs were collected from Government Cattle Breeding Farm, Agarpura. Milk yield was calculated for 300 days for all the animals.

Estimates of heritability and repeatability were determined by the methods already described (Taneja, 1955, 1958).^{4,5}

TABLE I

Heritability of milk yield in Malvi cattle for daughter-dam comparison

Charac- ter	d.f.	x_D^2	$x_D x_d$	b_{Dd}	h^2	S.E.	't' value
Milk yield	42	626164.2	135325.8	0.216	0.43	0.10	2.05*

* Significant at 5% level.

D = dam, d = daughter.

Results in Table I indicate that the regression of daughter (d) on the dam (D) for milk yield is statistically significant. Heritability was calculated to be 0.43 ± 0.20 .

TABLE II
Analysis of variance

Source of variation	d.f.	M.S.	'F' value
Between lactations	.. 1	77831.7	1.24
Between animals	.. 43	452823.9	7.23†
Residual	.. 43	62670.3	..

† Significant at 1% level.

Results in Table II indicate highly significant differences between animals ($F = 7.23$; $P1\% = 7.26$). Repeatability was estimated to be 0.76 ± 0.20 .

The estimate of heritability for milk yield in this breed is considerably high and mass selection can be practised to raise the milk production. The genetic improvement (ΔG) in the next generation depends upon selection differential (S.D.) and the heritability (h^2) since,

$$\Delta G = S.D. \times h^2.$$

Therefore, with higher estimate of heritability as found in this study, even less intense selection will be effective for improving the milk yield.

Just as the heritability determines the improvement in the next generation, repeatability determines gain in the future records of the selected group in that generation. The estimate of repeatability for milk yield in this study is considerably high, and is an important aid to selection.

We have great pleasure in expressing our indebtedness to Dr. R. L. Kaushal, Principal and Joint Director, Research, for his advice, guidance and continued interest in this investigation.

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OCCURRENCE OF A TENUIPALPID MITE ON GUAVA FRUITS IN MYSORE

A SERIOUS injury on fruits of guava (*Psidium guajava*) and to a lesser extent on citrus fruits was noticed on the Horticultural Farm at Maddur (Mysore State). The affected fruits showed brownish scalded patches on the surface, which in severe cases covered the entire surface and even resulted in splitting of the apical portion of the fruits (Fig. 1). These fruits, on close examination under a binocular microscope, revealed a reticulated pattern of fissures on the surface. A large number of a species of red mite was also seen, mainly concentrating along the fissures. All stages of the mite (egg, larva, nymphs and adult) were noticed. The females predominated, males being rarely encountered.

The mite has been tentatively identified as *Brevipalpus* sp. (Tenuipalpidae). There appears to be no record of the genus in India.

Brief descriptions of the different stages of the mite are given here :

Length : $257 \pm 16 \mu$.
Width : $121 \pm 5 \mu$.
Deutonymph : Red, oval, and flat ; with four pairs of legs.
Length : $220 \pm 10 \mu$.
Width : $120 \pm 5 \mu$.
Egg : Red, elliptical in outline.
Length : $100 \pm 5 \mu$.
Width : $63 \pm 2 \mu$.
Further work on the identity, host range, etc., of this species is in progress.

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CHROMOSOME NUMBER IN *ARNEBIA HISPIDISSIMA* (LEHM.) DC.

For this study the flower-buds were fixed in 1:3 acetic alcohol for meiotic studies. Smear preparations from young leaf tips were made following the usual aceto-orcein technique.

The pollen mother-cells at diakinesis and metaphase I showed four bivalents (Fig. 1). The disjunction of chromosomes at anaphase I was regular, four chromosomes being clearly visible at either pole (Fig. 2). Other stages of the first meiotic division were quite normal and indicated four to be the haploid chromosome number of the species. The somatic chromosome number was found to be $2n = 8$ as determined from a number of well spread metaphase plates (Fig. 3). Based on the size difference, the somatic chromosomes can be divided into three groups : (i) one pair of long chromosomes, (ii) two pairs of medium sized chromosomes, and (iii) one pair of short chromosomes.

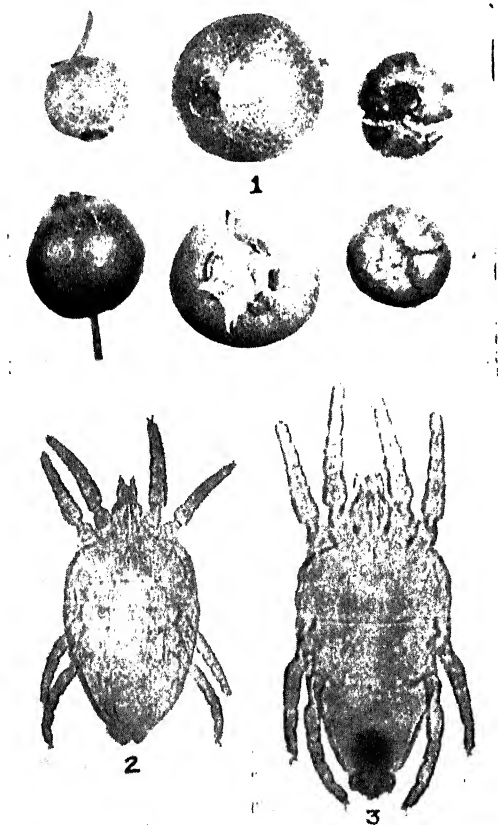


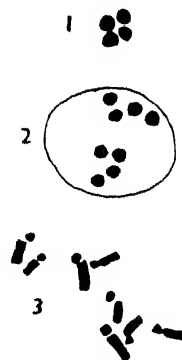
FIG. 1. Guava fruits showing typical damage caused by *Brevipalpus* sp.

FIG. 2. *Brevipalpus* sp., adult female, $\times 10$.

FIG. 3. *Brevipalpus* sp., adult male, $\times 27$.

Adult female (Fig. 2) : Almost inverted pear-shaped in outline ; flat, red, with the four pairs of legs and the anterior and the posterior ends of the body paler. Body divided into 3 distinct portions, gnathosoma, propodosoma and hysterosoma by transverse sutures. Dorsum with fine reticulations. Length (from the tip of the rostrum to the tip of the hysterosoma) : $284 \pm 10 \mu$. Width (in the widest region) : $136 \pm 10 \mu$.

Adult male (Fig. 3) : Same as the adult female, but with the posterior end a little more tapering and with the hysterosoma further divided into metapodosoma and opisthosoma by a transverse suture.



FIGS. 1-3 ($\times 1,420$). Fig. 1. Metaphase I (polar view) showing four bivalents. Fig. 2. Anaphase I with four chromosomes at either pole. Fig. 3. Somatic metaphase plate showing eight chromosomes.

As far as the authors are aware, the chromosome number of *Arnebia hispidissima* (Lehm.) DC. has not been reported so far. Our observations clearly indicate four to be the haploid number of this plant. It will be interesting to note that the only other plant in the family Boraginaceæ with $n = 4$ is *Amsinckia lunaris*.¹ It may be mentioned here that four is the lowest haploid chromosome number so far encountered in the family Boraginaceæ.¹

The authors are grateful to Principal Dr. A. N. Banerji, for the facilities and encouragement.

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OCURRENCE OF THE GENUS *SCOLECOBASIDIUM* ABBOTT IN INDIA

ABBOTT¹ isolated two new fungi from cotton and sugarcane soils from Louisiana. The distinguishing characters of these fungi were the shape and method of production of conidia on the conidiophores. Depending on the presence of thread-like nature of the sterigmata or basidia in both the cases, he proposed *Scolecobasidium* as the generic name, and since the conidial structures in both the isolates were different, he proposed *S. terreum* and *S. constrictum* as its species.

During the course of investigation on soil fungi of grasslands of Varanasi, the author isolated the same two species with some difference in characters from two different grass plots and which, to the knowledge of the author, have not been described so far excepting *S. constrictum* reported from soil of Georgia by Miller et al.²

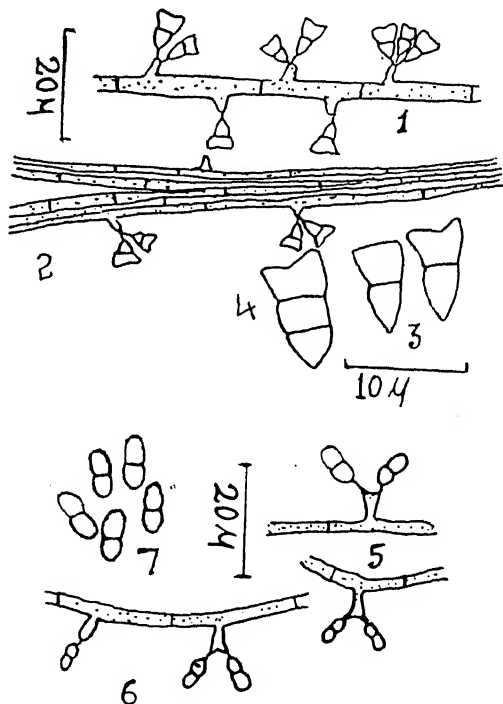
S. terreum was isolated at the depths between 7-12" from an alkaline grassland. The main grasses which compose this grassland during the rainy season and which come first in the order of frequency and dominance are *Setaria glauca* Beauv., *Cynodon dactylon* Pers., *Dicanthium annulatum* Stapf. and *Oplismenus burmannii* Beauv. Other herbaceous weeds which grow mixed along with these grasses are *Dactyloctenium aegyptium* Willd., *Cassia tora* Linn., *Evolvulus alsinoides* Linn., *Euphorbia hirta* Linn., *E. thymifolia* Linn., *Heliotropium supinum* Linn., *Polygala chinensis* Linn., and *Desmodium*

triflorum DC. The pH, moisture content and colour of the soil at this depth are 8, 15% and light-brown-grey respectively.

S. constrictum was isolated at the depths between 13-18" from a grass plot with *Saccharum spontaneum* Linn., *Dicanthium annulatum* Stapf. association. The other weeds growing along with these grasses are *Evolvulus alsinoides* Linn. and *Polygonum plabejum* Br. The PH, moisture content and colour of the soil at the depth are 7.5, 19% and light-brown respectively.

Scolecobasidium terreum Abbott

Colonies on oatmeal agar medium growing very slowly at 25° C., at first almost entirely submerged but later on developing sub-aerial hyphæ, greyish-black or dusky-brown, reverse of colonies brownish-black, resembling Broncho Old English Brown (Maerz and Paul,³ Pl. 8, 12 E); hyphæ septate, single or funiculose, olive yellow (Pl. 12, L₂); conidiophores arising as side branches from hyphæ, 3.6-7.2 μ long



FIGS. 1-4. *Scolecobasidium terreum* Abbott. Fig. 1. Attachment of conidia on conidiophores. Fig. 2. Funiculose hyphae. Fig. 3. T- and Y-shaped conidia. Fig. 4. Three-celled conidium.

FIGS. 5-7. *Scolecobasidium constrictum* Abbott. Fig. 5. Attachment of conidia on angular apices of the conidiophores. Fig. 6. Hyphae bearing conidiophores with rounded and angular apices. Fig. 7. Conidia.

and $2-2.7\ \mu$ broad; conidia T or Y-shaped, born at the tip of conidiophores attached by thread-like sterigmata, light olive-yellow to almost hyaline, smooth, 2-celled, $4.8-12.6 \times 2.4-3.2\ \mu$; sterigmata $0.5-1.0\ \mu$ long. Out of many, only three conidia were seen with three cells.

The fungus tallies with the type description in the method of production and structure of conidia but differs in bearing funiculate hyphae.

Scolecobasidium constrictum Abbott

Colonies on oatmeal agar growing very slowly at 25°C ., round, surface greyish-black: reverse greenish-black; hyphae at first submerged, later on producing dusky sub-aerial hyphae, olive-yellow (Pl. 12, L_2), septate; apices of the conidiophores of two types, viz., round and angular, conidiophores $3.6-7.2 \times 2.2-7\ \mu$; sterigmata $0.5-1.0\ \mu$ long; conidia oblong, slightly constricted at the centre, smooth, light olivaceous to almost hyaline, $5.4-14.4 \times 2.7-3.6\ \mu$.

The isolate agrees with the description given by Abbott¹ in every respect excepting the conidiophores which are of two types as mentioned above.

The author is grateful to Dr. R. Y. Roy for his guidance and criticism, to Prof. R. Misra, Head of the Department of Botany, for providing laboratory facilities and to the Government of India, for the award of a Scholarship.

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OCCURRENCE OF *HELMINTHOSTACHYS ZEYLANICA* HOOK. IN GORAKHPUR

Helminthostachys zeylanica Hook. has been found to occur in some swampy areas of western forest of South India up to an elevation of 3,000 feet and also in Bengal and Assam.¹ As far as we are aware, this monotypic genus has not been reported from any part of Uttar Pradesh or its adjoining areas.

Recently, while studying the vegetation of Gorakhpur and its neighbourhood, a good growth of this plant was found in a swampy area of Kushmi forest ($83^\circ 25'-83^\circ 30'\text{E}$, $26^\circ 40'-26^\circ 50'\text{N}$) seven miles east of Gorakhpur City. The swamp (pH of soil = 8) is characterized by the presence of a belt of wild *Eugenia heyneana* trees with which the fern has

been found to be closely associated. Another species found growing with these almost constantly is *Smilax prolifera*.

The specimen essentially conforms to the description given for *Helminthostachys zeylanica* by Beddome except for a high degree of variation in the form of the abaxial sterile portion of leaf which is ternately compound.² The leaflets vary from a simple and undivided condition to one with a highly dissected type (Fig. 1). The commonest type met with shows

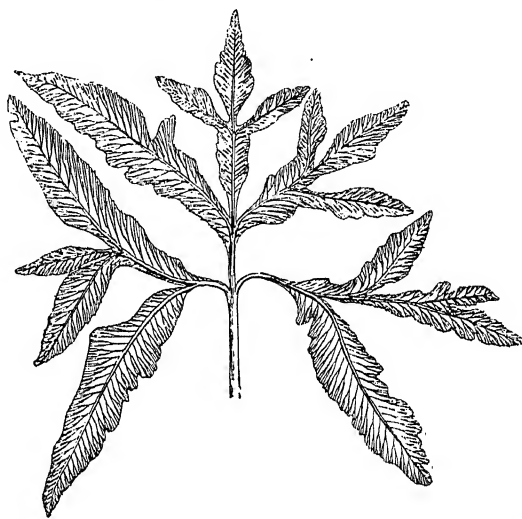


FIG. 1. Sterile segment of leaf showing variation, $\times 1/5$, the central leaflet divided into three and the laterals each into two lobes. The successive leaves produced by the same plant are similar to each other, however. The adaxial fertile portion does not show such variations.

A cross-section of the rhizome shows a medullated protostele with phloem masses wedged profusely in xylem elements. There is a clear endodermis demarcating the stele from the cortex. Most of the parenchymatous cells are richly laden with food materials. The rachis shows a dictyostele with short, more or less 'C'-shaped, meristeles. At its higher level the meristeles elongate tangentially and in the basal parts of the leaflets they may be highly elongated.

We are thankful to Prof. K. S. Bhargava for facilities.

Department of Botany, S. K. ROY.
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THE EFFECT OF PLANT REGULATORS ON SEX EXPRESSION IN RIBBED GOURD (*LUFFA ACUTANGULA* ROXBG.)

PLANT regulator treatments are known to influence greatly the sex expression in cucurbitaceous plants, leading to either suppression of the male flowers or increase in the number of female flowers per plant; in cucumber α -naphthalene acetic acid (NAA), β -indole acetic acid (IAA) and 2,4-dichlorophenoxy acetic acid (2,4-D) were found to suppress male flowers and promote female flowers.¹⁻³ In watermelon male sterility was induced by 2,4-D or tri-iodo-benzoic acid, without affecting the female flowers.⁴ The present investigations were undertaken with a view to study the effect of some plant regulators on the sex expression of ribbed gourd (*Luffa acutangula* Roxbg.).

NAA, 2,4-D and *p*-chlorophenoxy acetic acid (CIPA) were selected for the purpose. The seeds of ribbed gourd were sown in the field. The plants were sprayed with the plant regulators in aqueous solutions at regular intervals, starting from the seedling stage. Observations on the date of first flowering and the number of male and female flowers produced on each plant were made at periodical intervals. There were four plants under each treatment and the average data on the flowers and fruit set are presented in Table I.

TABLE I

The effect of whole plant sprays of plant regulators on sex expression and fruit set in ribbed gourd
(Average of four plants)

Treatment	First flowering after: days	Total no. of flowers	% female flowers	Total fruit set
Control 0 p.p.m.	38	952	2.9	16
NAA: 0.05 p.p.m.	42	874	4.0	16
25.0 p.p.m.	45	582	6.9	19
2,4-D: 0.05 p.p.m.	37	702	5.5	18
25.0 p.p.m.	41	416	8.2	21
CIPA: 0.05 p.p.m.	82	367	6.3	15
25.0 p.p.m.	93	198	9.1	25

Due to the spray treatments there was a reduction in the total number of flowers per plant, the maximum reduction of 80% being caused by 25 p.p.m. of CIPA. The chemicals also seem to alter the sex expression, which is mainly due

to a reduction in the number of male flowers per plant, thus causing an increase in the percentage of female flowers. There was considerable delay in flowering due to the CII treatments. The spray treatment with 25 p.p.m. of 2,4-D also caused the formation of male and female flowers in a cluster (the female or also having bracteoles like males) as against the solitary female flowers in the control plant (Fig. 1); the bracteoles at the base of pedicels of the male flowers were transformed into leafy structures (Fig. 2).

Thus there seems to be evidence in the present studies to suggest that a mechanism hormonal type is involved in sex determination in ribbed gourd. These results are in agreement with those reported for other cucurbitaceous plants.

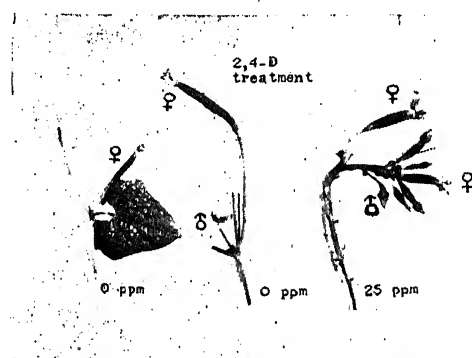


FIG. 1. Effect of whole plant sprays of 2,4-D (25 p.p.m.) on sex expression in ribbed gourd: cluster bearing of female flowers together with male flowers as against single female flowers in the control.

FIG. 2. A. Modification of bracteoles in the male pedicel into leafy structures due to whole plant sprays of 2,4-D; B, normal panicle from control plant.

ment with the findings of Laibach and Kribben¹ in cucumber with NAA.

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ON THE PECULIARITY IN THE CONJUGATION OF SPIROGYRA PUNCTULATA JAO

THE object of this note is to record a peculiarity in the conjugation of *Spirogyra punctulata* Jao¹ and the formation of triploid zygospores in nature. The material was collected from a freshwater stream at the foot of hills in Jalukbari, Assam, during the month of February, 1959, and identified by Mr. G. S. Venkataraman.

Vegetative cells 76-84 μ broad, 114-334.4 μ long; chloroplast 3-4, making 0.5-1 spiral; end walls plane; conjugation scalariform, tubes formed by both the gametangia; zygospores formed in the female gametangia; gametangia cylindric; zygospores elliptic with pointed ends, 68.4-79.8 μ broad, 95-121.6 (-155) μ long, brown when mature, exospore smooth, colourless, mesospore punctate. In the type material Jao¹ describes the zygospores as yellow but in the present form the mature zygospores are brown in colour.

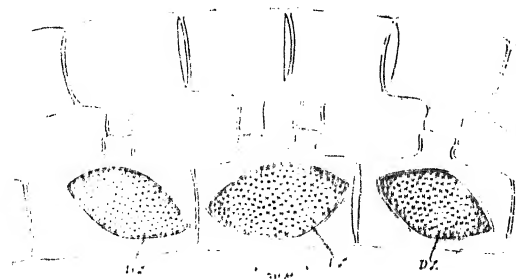


FIG. 1. Conjugating filament of *Spirogyra punctulata* Jao showing normal and abnormal type of scalariform conjugation (DZ, Diploid zygospore; TZ, Triploid zygospore).

In the normal scalariform conjugation, a single conjugation papilla is formed, one from the male and the other from the female gametangium and these two papillae fuse and open into one another. Besides this normal type of

conjugation, an abnormal mode of sexual fusion was observed. Here two male gametangia fused with a single gametangium (Fig. 1). In such cases two conjugation papillae, instead of one were formed from a single female gametangium, and these fused with the other two papillae, formed one from each corresponding male gametangium. Thus the resulting zygospores are likely to be triploids, instead of the normal diploid ones. There is, however, no morphological difference between the diploid and triploid zygospores.

The author records his sincere thanks to Prof. H. K. Baruah for his interest and encouragement and to Mr. G. S. Venkataraman for his suggestions and for identification of the material.

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A NEW BACTERIAL LEAF-SPOT OF CROTALARIA JUNCCEA L.

THE leaves of *Crotalaria juncea* L. (Sunn-hemp) with round water-soaked spots of about 1 to 3 mm. in size, surrounded by a distinct halo, were collected in August 1958 from the Institute of Agriculture, Anand. In the early stage these spots have a dark brown centre surrounded by a halo and as the spots enlarge the centre becomes whitish with a dark brown margin surrounded by a halo. The number of spots on each affected leaf varied from one to several (Fig. 1). Under favourable condition,

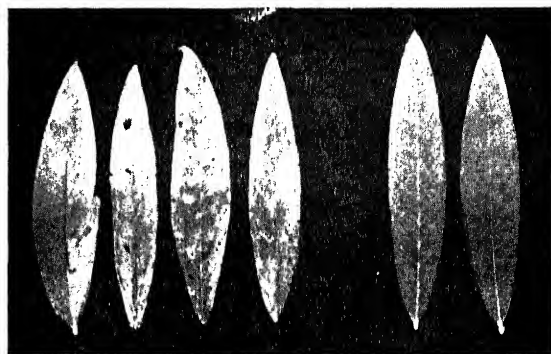


FIG. 1. Typical symptoms on leaves of *Crotalaria juncea* L. incited by *Xanthomonas patchii* Desai and Shah

in advance stage of disease development, the spots become irregular and coalesce involving major portion of the leaf. The lower leaves were found to be affected first and defoliate prematurely in severe cases. In some cases the tissues from the central portion of the spot become separated forming a shot hole.

Microscopic examination of several spots revealed masses of bacteria oozing out from the lesions (Fig. 2).

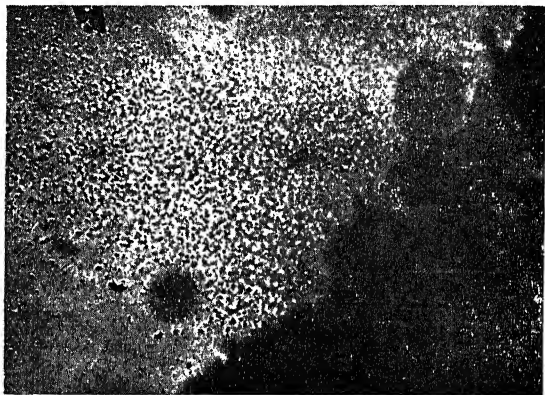


FIG. 2. Bacteria oozing out from the lesion.

On isolation, shining yellow-coloured colonies were obtained on Potato Dextrose Agar. The cultures thus obtained were purified and inoculated in leaves of sunn-hemp. The typical spots were developed on the leaves in ten days.

The organisms are short rods, gram negative, no spore, non-acid fast and motile by single polar flagellum. The size of bacteria varies from 1.18 to $1.64 \mu \times 0.54$ to 0.82μ .

Colonies on Potato Dextrose Agar are citron yellow, circular with entire margins, smooth, convex, glistening and butyrous; odour absent and colour of the medium unchanged. Nitrates not reduced, indole and ammonia not produced. Hydrogen sulphide produced and starch and casein hydrolysed.

The organism could incite spots on leaves of *Crotalaria juncea* L. but not on the leaves of *Desmodium diffusum* DC., *Vigna catjang* Walp., *Dolichos lablab* L., *Cajanus cajan* L. Millsp., *Gossypium hirsutum* L. and *Phaseolus vulgaris* L. It is, therefore, proposed to name the organism as *Xanthomonas patelii* sp. nov. after Dr. M. K. Patel who has significantly contributed to the knowledge of bacterial plant diseases.

Further work is in progress and will be reported elsewhere.

Dept. of Plant Pathology,
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Anand, April 17, 1959.

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H. M. SHAH.

CHROMOSOME MORPHOLOGY AND MEIOSIS IN *SMILACINA PALLIDA*

EARLIER cytological studies on this liliaceous genus have been made by Tahara,¹ Sato² in *Smilacina japonica*; Stenar³ in *S. racemosa*; Cave⁴ in *S. sessilifolia*; Rattanbury⁵ in *S. amplexicaulis*. Recently Therman⁶ investigated *S. racemosa*, *S. trifolia* and *S. stellata*. All these investigators have reported the chromosome number $2n = 36$ for the species studied.

Therman⁶ is of the opinion that the centre of origin of the entire tribe Polygonatæ, to which this genus belongs, lies in Eastern Asia. Little work has so far been done on the species occurring in this region. Hooker⁷ has described four species, *S. fusca*, *S. oleracea*, *S. oligophylla* and *S. pallida* occurring in Himalayas. Of these, only *S. pallida* Royle is distributed throughout the Himalayan range, the rest being restricted to Eastern Himalayas. Material collected from Narkanda, Simla hills, in Western Himalayas was used by the writer for cytological studies. The procedure followed consists in treating freshly cut root-tips in α -Bromonaphthalene for 1-2 hours, followed by smearing in acetocarmine, after mild hydrolysis in N HCl. Meiosis has been studied from PMC-anthers smeared in acetocarmine after fixation in Carnoy's fluid.

Somatic chromosome number $2n = 36$ and haploid number $n = 18$ has been noted (Fig. 1). The karyotype is asymmetrical consisting of short, medium and long chromosomes. The shortest chromosome measures 3.25μ and longest chromosome 12.25μ . There are three long chromosomes with nearly median constriction, and of these, one pair has a secondary constriction in the short arm. Eleven medium-sized chromosomes are present, and of these, two pairs show median or nearly median primary constriction and nine medium-sized chromosomes have subterminal primary constrictions. One pair of dissimilar medium-sized chromosome bears secondary constriction in the short arm. There are seventeen short chromosomes, 6 pairs with median or nearly median primary constrictions and five chromosomes with subterminal primary constrictions.

In all, there are four SAT chromosomes, one pair of long SAT chromosome S and S is morphologically identical, however other two SAT chromosomes S' and S'' are morphologically dissimilar (Fig. 1). The S' type is similar to the SAT chromosomes reported by Therman for the species studied. There are 2-3 nucleoli present in the nucleus of the somatic cells.

Structural heterozygosity in the chromosome complements is indicated by the presence of some odd chromosomes—for which it was not possible to find out the morphological homologue. One pair of SAT chromosome S' and S'' are dissimilar (Fig. 1). Such structural hybridity in the karyotype has earlier been reported by Therman⁸ in different European strains of the allied genus *Polygonatum verticillatum*. Recently the present author (Kumar¹⁰) has also reported structural hybridity in the Himalayan forms of the same species.

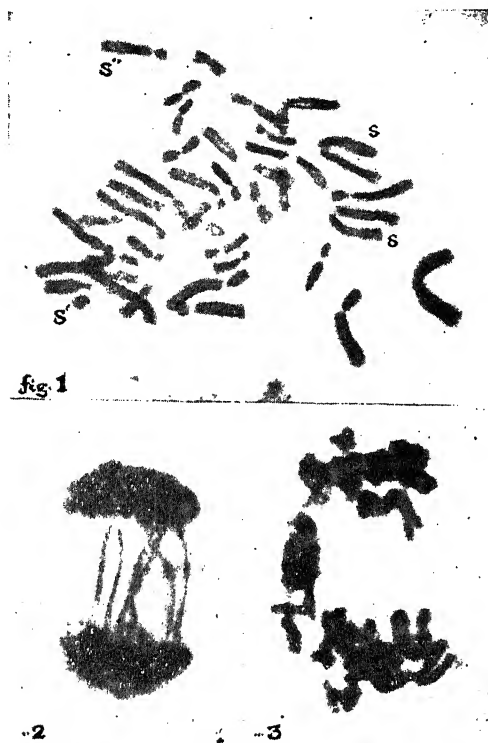


FIG. 1. Metaphase in Root Tip Cell showing 36 Chromosomes.

FIGS. 2 & 3. Anaphase I, showing Meiotic Abnormalities.

At Anaphase I of meiosis certain irregularities like dicentric bridges and acentric fragments and stickiness in the separating chromosomes were observed, thus revealing heterozygosity for inversions (Figs. 2, 3). Since the plant possesses an efficient mode of vegetative reproduction by rhizomes—such irregularities probably tend to accumulate in the genus. It is likely that the cumulative effect of these structural changes may be of help in bringing about new chromosome types, and thus increasing the phenotypic variability within the species.

Regarding the basic number for the genus, the haploid number $n = 18$, so far known for the various species, seems to be high to be the primary basic number. However, Darlington and Wylie¹¹ have kept $n = 9$ as the basic number for the genus. It is quite likely that the various species studied so far may be of polyploid origin. Autopolyploidy seems unlikely, since most of the chromosomes are repeated once only and the course of meiosis is also unlike those of autotetraploids.

The author is deeply indebted to Dr. M. S. Swaminathan, Cytogeneticist, I.A.R.I., for the encouragement and valuable suggestions which the author received during the course of this study. Thanks are also due to Mr. Jagdeshan for his help in photomicrography. The author is also grateful to Mr. M. M. Begg, Principal, Delhi College, for his encouragement and to the Ministry of Scientific Research and Cultural Affairs, for a 'Grant-in-aid'.

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PYGIDIAL GLANDS IN *PHEROPSOPHUS* SP. (CARABIDAE: COLEOPTERA)

The nocturnal beetle *Pheropsophus* has been observed to eject a strong jet of volatile fluid with an audible sound through a pair of openings at the tip of its abdomen either to paralyse its prey or to escape from its enemy. The fluid is discharged by a pair of pygidial or anal glands (Bordas, 1899) which serve as organs of offence and defence.

Dierckx (1901) studied the pygidial glands in some Coleoptera. The glands in *Pheropsophus* are a pair of symmetrical structures lying below the abdominal terga VI-X, one on either side of the rectum and above the aedeagus in the male and vagina in the female. Each gland consists of a group of secretory lobes, their collecting tubes, the reservoir and the capsule opening to the exterior on the tenth tergum (Fig. 1).

There are a dozen secretory lobes which appear like bunches of white grapes, each with 5-7 small, radiating branches which meet in the centre and are free distally. A long, convoluted, slender collecting tube leads from the

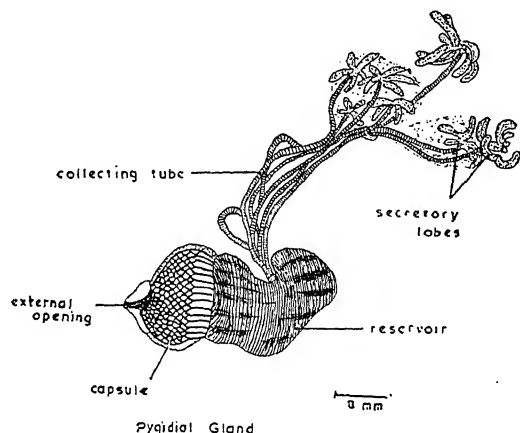


FIG. 1

centre of each lobe and all the collecting tubes join distally to form a common collecting canal which opens into the reservoir at the latter's mesial concavity. Each collecting tube is supported by annular thickenings along its length. The reservoir is a large, thick, bean-shaped structure of a dirty-white colour, richly supplied with tracheæ. There is a thick outer layer of circular muscles whereas the inner lining of its wall forms long plaits which either meet similar plaits from the other side or fuse with the wall opposite, with the result that the cavity of the reservoir is cut up into small spaces and the whole structure presents a

sponge-like appearance. The reservoir in fact is a storehouse for the fluid which is forced through the capsule to the exterior by the contraction of its walls. The reservoir opens distally into the capsule by a wide transverse opening. The capsule is a strongly sclerotized, rounded, hollow receptacle with a well chitinized rim round its proximal opening. The surface of the capsule is marked by alveoli, surrounded by ridges which are fringed with bristles. The alveoli are filled with a brown granular substance and the capsular muscles are inserted on the surface of the capsule. The cavity of the capsule leads posteriorly into a wide, weakly sclerotized excretory duct which opens to the exterior on the tenth tergum. The histological details of the various parts will be reported later.

The beetles in captivity, when roughly handled, produce the fluid. It is almost colourless and has a pungent odour. It stains the surface on which it is thrown, leaving a greenish-yellow residue on evaporation. The secretion is corrosive and produces an irritation lasting for a few hours. It is soluble in water and has no reaction with litmus but turns ferrous sulphate solution black, which shows that it contains oxides of nitrogen. According to Wigglesworth (1950) the secretion is said to contain nitrous acid and nitrites in some bound form.

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ACOUSTICAL MEANS OF STUDYING GRAVITATIONAL WAVES

THE field equations of general relativity predict that a rotating body will radiate a gravitational wave. Thus a rod of length 1 m. and mass 1 kg. rotating at 100 rps., according to Eddington (*Mathematical Theory of Relativity*) would radiate gravitational flux at the rate of 6.4×10^{-30} erg/sec. Prof. J. Weber, of the University of Maryland, has suggested possible acoustical means of detecting and generating such radiation. Gravitational waves striking a solid will set up strains in it, and these might be detected by suitable and sufficiently sensitive piezo-electric crystal attached to the solid. To achieve sufficient sensitivity to observe gravitational radiation from outer space it might be necessary to use as the vibrating mass a moun-

tain or even the earth itself, provided seismic disturbances could be effectively screened out.

A vibrating solid might serve as a terrestrial source of gravitational radiation. Prof. Weber shows that a quartz cube treated as a mass quadrupole radiator might under feasible conditions radiate as much as 10^{-15} erg/sec. of gravitational flux. This could be materially increased if the tensile strength could be increased. At present reception does not seem practicable for intensities less than 2×10^{-8} erg/cm.²/sec. Details of Weber's work are not available but acousticians will be interested in this fascinating field of modern physics.—*J. Acoust. Soc. Am.*, 1959, **31**, 1040.

REVIEWS

Sound Pulses. By F. G. Friedlander, (Cambridge University Press), 1958. Pp. ix + 202. Price 40 sh.

It has been said that the development of the theory of sound would not have taken the course that it did if it were not for presence of a sound receiving organ in man. The human ear and Fourier's analytical theory conspired to set the pattern for the analysis of sound waves in terms of harmonic waves. The general technique of obtaining harmonic solutions of the wave equation appropriate to the prescribed initial and boundary conditions proved to be so fruitful that even aperiodic disturbances were analyzed (or synthesized) in terms of harmonic components.

The treatment of acoustic pulses in this book is based on the theory of linear hyperbolic partial differential equations. In this theory it is easily established that pulse-fronts, considered as hyper-surfaces in space-time, are characteristics of the wave equation. Pulse-fronts are reflected, propagated and diffracted in accordance with Fermat's principle and we thus have a body of theory which may be called geometrical acoustics.

Starting with the equations of motion of an inviscid medium, this monograph develops the concepts of wave-fronts and characteristics in space-time. The chapters that follow give a more complete discussion of the applications of geometrical acoustics to problems of reflection and diffraction. Diffraction of a pulse by wedge, half-plane, circular cylinder and sphere by the use of Green's functions receive a thorough treatment.

In the words of the author this book is essentially an essay on the pulse solutions of the wave equation. The treatment is essentially mathematical and can be of interest not only to workers in acoustics, but also in the field of electromagnetic theory.

B. S. RAMAKRISHNA.

Beneficiation of Low Grade Manganese Ores of India. P. I. A. Narayanan and N. N. Subrahmanyam. (Council of Scientific & Industrial Research, New Delhi), 1959. Pp. 183. Price Rs. 10-00.

This monograph is based on the comprehensive studies made by the authors and their

collaborators at the National Metallurgical Laboratory, Jamshedpur, on the possibility of beneficiating different types of low grade manganese ores available in India. Indigenous production of exportable grades of standard ferromanganese, rather than the export of raw high grade ore, has been accepted as a problem of national importance. But so far adequate attention has not been given to beneficiation and upgrading of low grade ores with a view to their economic utilisation. This monograph becomes at once important, particularly when one realises that 1 to 2 tons of low grade ore are discarded at the mine-site for every ton of high grade ore mined.

The first chapter gives the occurrence of manganese ores in India and other countries. The second and third chapters cover the production, export, consumption, price, uses and specifications of manganese ores. Chapter Four deals with methods of beneficiation and Chapter Five discusses the beneficiation studies made on Indian low grade manganese ores from different parts of the country. The authors summarise their work on this subject and give their recommendations in the final chapter of the monograph.

The monograph with its numerous tables, graphs and illustrations will be of great use to industry and trade concerned with manganese ores either for export or as raw materials for the production of ferro-alloys. The monograph is neatly printed and attractively got up.

A. A. KRISHNAN.

A Handbook of Colorimetric Chemical Analytical Methods. (Published by the Tintometer Ltd., Salisbury, England), 1959. Pp. 360. Price 30 sh.

The fifth edition of this illustrated book has been wholly rewritten and brought up to date and the book itself is now redesigned in loose-leaf form so that the tests can be conveniently revised or modified and incorporated. The published price covers also the cost of revision leaflets for a period of two years.

The book is divided into seven parts dealing with the apparatus used, pH, inorganic chemical analysis, organic chemical analysis, chemical pathological methods, noxious vapours and colour grading for quality respectively. More

than 150 complete analytical tests are incorporated.

This is an excellent book for its purpose and it should be in every chemical library and in all laboratories where Lovibond colour scale is adopted for colour comparison.

N. J.

The Mammals of North America. Two volumes. By F. Raymond Hall and Keith R. Kelson. (The Ronald Press Company, New York), Pp. 1083 + 79. Price \$35.00.

This is a truly outstanding achievement. Not within a hundred years has an account of the mammals of North America appeared and it is clear that this work fills an important need. It has been a colossal undertaking, involving a great amount of labour and expense and the collaboration of a number of specialists. Dr. Hall's dedication of a life-time for the guidance and preparation of the work, and the devoted efforts of Dr. Kelson have been responsible for producing a book of monumental importance, one which will remain on the reference shelves of all whose work even remotely touches on mammals.

Over 3,000 species and subspecies are described here. The distribution of every one is shown on a map and drawings of a very large number of typical mammals have been made, along with their skulls. Their arrangement in the book is illustrative of what is known of their evolutionary sequence, starting with the Marsupialia. Even within each order, family or genus, the species known to be the oldest is treated first, the other species being listed according to their age.

One of the interesting features of taxonomic work in recent years is the gradual decrease in the number of species described. For instance, the number of species of North American mammals recognized in 1923 was 1,399; in 1953 it was 1,065; in 1957 (in the book under review) there are little more than 1,000. This decrease is largely due to the recognition of the fact that many of the species described earlier could now be regarded only as subspecies. It shows the trend of modern taxonomy, the necessity to recognize resemblances, even as, over a hundred years ago, Darwin himself did. Far too many species are listed and described, even as it is; but with the recognition of the basic unity underlying living organisms, the trend is sure to continue, and in other animals as well in mammals, a stable discipline will result—the New Systematics.

B. R. S.

Cytology and Cyto-genetics. By Carl P. Swanson. (Macmillan & Co. Ltd., London), 1958. Pp. 596. Price 45 sh.

The establishment and elaboration of the Chromosome Theory of Inheritance imperceptibly ushered in the current phase of analyses of the nature of the gene, its reproduction and mode of action. The corpuscular discrete gene of classical Genetics has given place to the *operational gene* defined. "as the smallest segment of the gene string that can be shown to be associated with the occurrence of a specific genetic effect" (p. 425). Its rather blurred boundaries is reminiscent of Goldschmidt's contention that the *hypothetical gene* of classical Genetics has no existence, that mutations are merely rearrangements of the chromosome at microscopic and sub-microscopic levels and that the hereditary potentialities are determined by the spatial relationships within the chromosome.

In that context the answers to the questions: "What is the chromosome?", "What does it do?", and "Why does it do what it does?", considered in this volume, are of topical interest. "The reader will observe that few definitive answers can be given, but it is believed that these discussions will be useful to those working in the immediate fields of cytology, genetics and evolution and also those in the areas of cellular physiology, embryology, systematism, medical research and plant and animal breeding" (p. vii).

A good background in Cytology is essential to appreciate the book and the brevity of treatment of the many problems stimulates but does not satisfy the curiosity of the reader. The volume would afford much food for thought to active investigators in the field.

M. K. SUBRAMANIAM.

Implantation of Ova—Memoirs of the Society for Endocrinology. No. 6. Edited by P. Eckstein. (Cambridge University Press, Cambridge, England), 1959. Pp. 96. Price 10 sh. net.

The present memoir of the Society for Endocrinology is the proceedings of a Conference held in November, 1957 to survey the vital phase in mammalian development during which the fertilised ovum becomes embedded within the uterine mucosa. The papers presented at the Conference have been arranged sequentially on the basis of morphological, histochemical and physiological studies.

The memoir is fittingly prefaced by an admirable general survey of ovum implantation

in mammals. The authors (Eckstein, Shelesnyak and Amorose) have outlined the nidational patterns in mammals and their variants, against a perspective of the analytical approaches that could be made for probing into the mysteries of the implantation problem. Harrison and Neal's paper is an account of the peculiar delayed implantation in European badger. The physiological mechanisms responsible for this phenomenon are still imperfectly understood but the authors have been able to show that at least the corpus luteum does not play any important role in the mechanism. Boyd's demonstration of the presence of intra and extracellular glycogen in certain anatomical components of the human implantation site is perhaps the first of its kind ever done. Lutwak-Mann has reviewed her notable contributions to the biochemistry of implantation. For obvious reasons, the reviewer feels that this is one of the most important papers in the memoir. The superb photographs of 6-day guinea-pig blastocyst from *in vitro* cultures (taken by Blandau) presented by Amorose chronicle the progressive morphologic changes in the attachment cone. The findings are in complete agreement with the classical studies of Graf von Spee and the relatively recent investigations of Blandau. On the pharmacologic side Robson has studied the effect of, a number of compounds (spindle poison, chromosomal poison and antimetabolites) on pregnancy in mice. Shelesnyak reiterates his earlier view regarding the involvement of histamine in the process of decidua formation and nidation. The most significant point which emerges from this memoir is the concept of relative autonomy of the ovum within the uterus and the synchronization of some of the metabolic events in the ovum and the uterus to maintain this autonomy.

The present number of the *Memoirs of the Society for Endocrinology* like its predecessors is a worthy publication and research workers would look forward to the appearance of other numbers in this series devoted particularly to problems of mammalian reproduction.

A. B. KAR.

Journal of Medicinal and Pharmaceutical Chemistry. Vol. I, No. 1. (Interscience Publishers, New York, London), 1959. Pp. 1-120. (Bi-monthly Subscription £ 5-15 per year.)

Early dissemination of the results of research activities of the various laboratories is sure to benefit the scientists engaged in allied types of research. This new journal may be expected to fulfil this objective efficiently and quickly.

The increased tempo of pharmaceutical and pharmacological research all over the world is reflected in the pages of this journal.

The strong Editorial Advisory Board consisting of reputed Chemists and Pharmacologists is indicative of the international character of the journal. The main articles presented and discussed in this volume are:—

Hypotensive hydrazinophthalazines, pyrrole derivatives as a new class of antispasmodics, Alpha and Beta proline type of compounds, Chemistry and Pharmacology of some synthetic organophosphorus compounds, derivatives of 3-Pyrrolidinols, compounds related to Pethidine and natural products from *Piper methysticum* Forst.

M. SIRSI.

Acetophenetidin. By Paul K. Smith. (Interscience Publishers, New York, London), 1958. Pp. x + 180. Price \$ 5.75.

This volume is the fourth in the series of monographs published by the Institute for the Study of Analgesic and Sedative Drugs. The chief value of this series lies in making available in one volume the pertinent literature found scattered in various journals all over the world.

Acetophenetidin, introduced as an antipyretic in 1887, is one of the very few drugs that has stood the test of time. It still occupies a prominent place amongst the innumerable, antipyretics and analgesics of recent origin.

This monograph on phenacetidin also deals with the major metabolite of this drug—N-acetyl-p-amino phenol. The aspects reviewed cover physical, chemical, biochemical, biological and pharmacological properties of these two compounds and ends with a comprehensive bibliographical index.

M. SIRSI.

Advances in Clinical Chemistry. Vol 1. Edited by Harry Sebotka and C. P. Stewart. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1958. Pp. xi + 308. Price \$ 12.00.

The first volume of the new series, *Advances in Clinical Chemistry*, with its laudable object of presenting an unbiased and critical discussion of many border-line subjects, is a worthy companion for the already well recognised 'Advances' Series.

Progress of medical science is mainly dependent on elucidating the fundamental biochemical abnormalities which underlie disease processes. Emphasis on this aspect has resulted in a new

and highly desirable orientation to clinical chemistry in this volume.

The topics discussed are widely divergent in nature. Plasma iron; the assessment of the tubular function of the kidneys; protein-bound iodine; radioactive iodine-131 in the diagnosis of hyperthyroidism; adrenocortical steroids; 5-hydroxy indoles; composition of the body fluids in childhood; clinical significance of transaminase activities of serum and paper electrophoresis in clinical investigations are the subjects dealt with in this volume.

The importance of these selective subjects needs no emphasis since they are in the forefront of clinical research all over the world. They are presented in a manner highly stimulatory and thought-provoking. The volume is a useful companion for both clinical chemists and clinicians.

M. SIRSI.

Tabulated Information on Tropical and Sub-Tropical Grain Legumes. (Plant Production and Protection Division, Food and Agriculture Organization of the United Nations, Rome, Italy), 1959. Pp. xiv + 367. Price \$ 3.50.

Grain Legumes or pulses are those leguminous plants which produce seeds or grain used primarily for human consumption. They include such important crop plants as groundnuts, soyabeans, lentils, peas, pigeon peas and the many other types which could, if properly developed, make a great contribution to human nutrition, particularly in tropical and sub-tropical countries where diets are generally deficient in proteins, fats and oils.

This publication brings together for the first time a wealth of information collected by the FAO from authentic sources from the various countries of the globe enclosed between 25° Latitude North and South.

The tabulated information consists of about 360 information sheets, one for each individual species or variety, arranged in alphabetical sequence. The information in each sheet consists of Identification, Station submitting the information, Source of crop, Genetic origin, Uses, Seed availability, Major insect pests, Major diseases, Morphology and Habit, Culture, Resistance to (factors), Yield and Quantity.

A publication such as this helps specialists in those regions to know what others possess in the way of varieties of these important crops and to pool their knowledge and experience.

Agricultural Research in India—Institutes and Organisations. By Dr. M. S. Randhawa. (Indian Council of Agricultural Research, New Delhi), 1958. Pp. v + 448. Price Rs. 20.00.

The importance of scientific development of agriculture in India cannot be overemphasized when it is realized that nearly 80% of her population live in villages and are directly dependent on agriculture for a living. Traditional methods of cultivation, harvesting of crops and marketing of the products according to the native genius of the people of the locality, though excellent in their own way, have certain inevitable drawbacks which are brought to the forefront under the rapidly changing conditions of living, the growing economy of the country as a whole and, above all, the increasing population where the rate of increase is threatening to outstrip the resources of the environments.

At the turn of the present century there was a general awakening of interest in the scientific study of agriculture in all the advanced countries of the world and this had its impact in India as well. The first fruit of this impact was the scheme to establish by the then Government of India, agricultural research institutes, experimental farms and agricultural colleges in different parts of the country. It was in the year 1905 that a munificent donation of £ 30,000 by Mr. Henry Phipps, an American philanthropist, enabled the establishment of the first Government of India Agricultural Research Institute (IARI), popularly known as the Pusa Institute, after the name of the village in Bihar where it was started. After the disastrous Bihar earthquake of 1935, the Institute was transferred to Delhi. In recent years under the aegis of the Ministry of Food and Agriculture rapid expansions have taken place in the IARI not only in buildings and expert staff but also in laboratory facilities, scientific equipments and experimental farms. It stands today as the premier institution of the country and one of the important sources of expert technical knowledge, advice and instruction in agriculture and its cognate branches.

After the First World War, as a result of the constitutional changes of 1919, agriculture became a provincial government subject and there was no agency between the Centre and the provinces to bring about co-ordination of work. In 1928 the Indian Council of Agricultural Research was established as a statutory body, with the primary function of promoting, guiding and co-ordinating agricultural research

throughout India. With the advent of freedom the Council has developed into a premier organisation which guides, finances and co-ordinates research problems connected with agriculture and animal husbandry. Another important function of the ICAR is the dissemination of results of research.

The volume under review *Agricultural Research in India—Institutes and Organisations* by the Council's Vice-President, Dr. M. S. Randhawa, gives an exhaustive account of the nine Central Research Institutes and seventeen Central Commodity Committees (pertaining to Cotton, Jute, Coconut, Oilseeds, Sugar, Lac, Tobacco) their research activities and achievements. It also contains the details of all research schemes sponsored by the ICAR.

Excepting the specialists who deal with researches and research organisations not much is known to the general public, and even to administrators in other fields, about the activities of the institutes and laboratories functioning under the Central Ministry of Agriculture. The present volume supplies the need by providing an integrated account of these research institutions and their organisation and activities. The volume is attractively got up and contains 79 plates of photographs and maps giving a wealth of information at a glance. The reviewer has it at his desk as a ready reference volume and he feels sure that every library, editorial and research establishment, administration department, agricultural institute and college will own a copy of this informative publication.

A. S. G.

Books Received

- Discovery Reports*, Vol. XXIX. *Octocorals* (Part I) *Pennatularians*. By H. Broch. Pp. 245-80. Price 17 sh. 6 d.; *The Foetal Growth Rates of Whales with Special Reference to the Fin Whale, Balænoptera physalus* Linn. By R. M. Laws. Pp. 281-308. Price 12 sh. 6 d.; *Distribution and Life-History of Euphausia triacantha* Holt and Tattersal A. de C. Baker, Pp. 309-340. Price 15 sh. (Cambridge University Press, London N.W. 1).
- The Analysis of Mixtures of Volatile Substances*. By Emil F. Williams and others. (*Annals of the New York Academy of Sciences*, Vol. 72, Art. 13), 1959 Pp. 559-785. Price \$ 4.00.
- Chlorpropamide and Diabetes Mellitus*. By M. G. Goldner and others. (*Annals of the New York Academy of Sciences*, Vol. 74, Art. 3), 1959. Pp. 407-1028. Price \$ 5-00.
- Quantum Aspects of Catalysis—The Drying of Linseed Oil*. By Raymond R. Myers. (*Annals of the New York Academy of Sciences*, Vol. 79, Art. 1), 1959. Pp. 1-8. Price 50 cents.
- Antibiotics Annual 1958-59*. Edited by Henry Welch and Felix Marti Ibanez. (Interscience Publishers, New York-1). Pp. xxii + 1107. Price \$ 12.00.
- Virus Growth and Variation*. Edited by A. Isaacs and B. W. Lacey. (Cambridge University Press, London N.W. 1), 1959. Pp. viii + 272. Price 35 sh.
- Excursion Flora of the British Isles*. By A. R. Clapham, T. G. Tutin and E. F. Warburg. (Cambridge University Press, London N.W. 1), 1959. Pp. xxxiii + 579. Price 22 sh. 6 d.
- Trigonometric Series*, Vols. 1 and 2. II Edition. By A. Zygmund. (Cambridge University Press, London, N.W. 1), 1959. Pp. xii + 383; vii + 354. Price 84 sh. each.
- Astronomy*, VII Edition. By Robert H. Baker. (D. VanNostrand Co., 358, Kensington, High Street, London W. 14), 1959. Pp. viii + 547. 52 sh. 6 d.
- I.C.A.R. Misc. Bulletin No. 82—Bovine Stars of India*. (Indian Council of Agricultural Research, New Delhi). 1957. Pp. 29. Price Rs. 2-37.
- Plant Nematodes, Their Bionomics and Control*. By J. R. Christie. (Agricultural Experimental Station, University of Florida, Gainesville, Florida), 1959. Pp. xi + 256.
- Biochemical Society Symposia No. 16—The Structure and Function of Subcellular Components*. Edited by E. M. Crook. (Cambridge University Press, London N.W. 1), 1959. Pp. 100. Price 15 sh.
- Electricity, Magnetism and Atomic Physics*, Vol. II—*Atomic Physics*. By J. Yarwood. (University Tutorial Press Ltd., Euston Road, London N.W. 1; India: Oxford University Press, Mount Road, Madras-2), 1958 Pp. viii + 644. Price 40 sh.
- Mites, or The Acari*. By T. E. Hughes. (The Athlone Press, London W.C. 1). Pp. vii + 225. Price 42 sh.
- The Two Cultures and the Scientific Revolution*. —The Rede Lecture by C. P. Snow. (Cambridge University Press, London N.W. 1), 1959. Pp. 51. Price 3 sh. 6 d.
- Introduction to Robot Technique—Multivibrator Circuits*. By A. H. Bruinsma. (Philips Technical Library, Eindhoven; India Philips India Ltd., Calcutta-20), 1959. Pp. 65. Price Rs. 5-00.

SCIENCE NOTES AND NEWS

Award of Research Degree

Andhra University has awarded the D.Sc. Degree to Sri. E. Bhagiratha Rao and Sri. P. Venkata Rao for their theses entitled "Studies on Drifts and Travelling Disturbances in the Ionosphere" and "Analysis of Electrical Machinery" respectively.

Symposium on Pilot Plants

Under the auspices of the National Metallurgical Laboratory, Jamshedpur, a Symposium on "Pilot Plants in Metallurgical Research and Development" will be held early in February 1960. Technologists and Research Scientists in the field are expected to contribute papers for discussion and take part in the Symposium. For further particulars please write to Dr. T. Banerjee or Mr. R. M. Krishnan, NML, Jamshedpur.

Symposium on "Hydraulic Machines"

A Symposium on "Hydraulic Machines" will be held in the last week of October in the Civil and Hydraulic Engineering Section of the Indian Institute of Science, Bangalore, in connection with the Golden Jubilee Year Programme of the Institute. Those interested in participating in the Symposium may please contact the Convener of the Symposium on "Hydraulic Machines", Civil and Hydraulic Engineering Section, Indian Institute of Science, Bangalore-12, for further details.

Fast Neutron Reactor

The August issue of the *Atomic Energy* magazine reports that the USSR has fully brought into commission a 5,000 kw. fast neutron reactor, the "BR-5". The reactor permits the use of Uranium-238 and Thorium for electric power generation. This will make the building of industrial atomic power stations economically profitable.—*USSR News*, August 21, 1959.

Gas Sterilisation of Seeds to Combat Pests

A new method of combating agricultural pests by treating seeds with gaseous nitrogen dioxide and ethylene monoxide has been evolved by Russian scientists. Experiments have shown that the pre-sowing gas treatment of seeds destroys all organisms causing infectious plant diseases of microbic, virus and helminthic

origin. Even the most hardy spore micro-organisms perish completely. Gas sterilisation of seeds has no effect on their vitality. Maize grown out of sterilised seeds in experimental fields stood four metres high, and cotton had 25 to 27 bolls in every plant. There was no case of disease among experimental plants throughout the season.—*Soviet News*.

The Compton Current

The absorption of energetic X-rays and γ -rays by an insulator is due mainly to the Compton effect. It is also known that the Compton electrons are scattered preferentially in the forward direction. If, therefore, a unidirectional beam of X-ray or γ -ray photons falls on a slab of an insulator, there should be an electron current following the Compton effect. With present high-intensity radiation sources this Compton current can reach appreciable values and can be measured by suitable means. Incidentally, a measurement of the current can give information on the absorbed radiation dose.

In a recent paper (*Zeit. fur Phys.*, 1959, 155, 479), B. Gross has discussed the theory of the Compton current and derived an approximate expression for its value based on some experimentally valid assumptions.

In the experiment to test the theory, a beam of γ -rays of 1.26 Mev. from a Co-60 source is made to fall on a sheet of plexiglas in contact with a lead cube which acts as the collector of the Compton electron flux and at the same time completely absorbs the γ -ray beam. Since plexiglas has a low atomic number it also minimizes backscattering. A potentiometer system using a vibrating reed electrometer as a detector is employed to measure the current. The result of the experiment is shown to confirm the theoretical conclusions.

International Panel on Heavy Water Reactors

At the Second United Nations Scientific Conference on the Peaceful Uses of Atomic Energy, held in Geneva in September 1958, there was a proposal for holding panel discussions for exchange of experience in some specialized fields related to the basic design of reactors. Considerable work on reactor design has been done independently in different countries. If the data obtained from this work were co-ordinated

and made generally available, a great deal of duplication of effort could be avoided. It was suggested that the IAEA (International Atomic Energy Agency) should take the initiative in arranging international co-operation in this field.

After examining the various aspects of reactor physics, the Agency decided to convene a panel to review, assess and correlate data on the physics of heavy water "lattices". For various reasons there is a widespread interest in the use of natural uranium as reactor fuel, and this has focussed attention in the design of heavy water moderated reactors. The term "lattice" refers to the pattern in which the fuel elements and the moderator are arranged in a reactor. The panel which met in Vienna from 31st August to 4th September 1959 was attended by leading scientists from different countries which have made significant progress in reactor physics and design. The publication of the results of the panel discussion will be a major contribution in reactor physics which will benefit all interested in the subject.

The Earth, Rockets and Meteors

Artificial satellites and rockets have become an important means of investigation of meteoric bodies in space. Particularly valuable data were obtained when they entered rather dense swarms of meteors. Each year our planet regularly meets certain streams of meteors, and at present the Earth is passing through the big Perseids meteoric stream, named after the Perseus constellation from which the cosmic particles seem to come. The existence of this stream, the largest known today, was known 1,200 years ago. It is scores of millions of kilometres wide and the total weight of the meteoric bodies it contains is about 500 million tons.

The Earth passed through the densest part of the stream on August 11-12. At this time the number of "falling stars" in the sky reached 50 to 60 an hour.

Sputnik III carries special apparatus to register the number of meteoric particles that strike its surface and their energy. With these apparatuses the density of meteoric matter in space surrounding the Earth has been determined. Calculations showed the average number of collisions was 0.1 to 0.15 per square metre per second. But at times, when the Sputnik passed through meteoric swarms, the number rose to several dozen and even hundreds.

A particularly important study of meteoric bodies was made by the cosmic rocket launched last January 2 that became a satellite of the sun. When the radio signals were deciphered and the calculations made, it was found that meteoric particles with a mass of about one-millionth of a gram strike the surface of the rocket once in several hours of flight.—(Article by V. Lutsky, through the courtesy of the USSR Embassy in India.)

Orientating Action of Polarised Light on Certain Dye Molecules

The following simple but remarkable phenomenon has been reported by A. Teitel, in *Die Naturwissenschaften*, 1957, Vol. 13, p. 370. A film of gelatine spread on a microscope slide and stained with a suitable dye, such as Congo Red, represents a surface which—when moist—is sensitive to polarised light. If the film is irradiated with white polarised light during the drying process, the irradiated spot exhibits a more or less permanent birefringence. Thus an invisible birefringent image of the light source or of a diapositive may in this manner be impressed on the surface, the image becoming visible only if the slide is viewed between crossed polaroids. As a detector of *partially* polarised light such a surface has an advantageous feature: in contrast to a usual analyser such as a nicol (which responds also to half of the unpolarised part of the incident light) the dye surface responds only to the polarised part, and hence may be useful for detecting feeble traces of polarisation.

The axes of birefringence of the irradiated spot lie along and perpendicular to the electric vector of the light, the latter (according to the explanation of Teitel) causing a mechanical orientation of the dye molecule. The observed sign of the birefringence is explicable only if the molecules tend to align themselves with their lengths perpendicular to the electric vector of the light, so that it must further be supposed that the light acts on certain active side radicals which lie perpendicular to the length of the molecule.

New Theory of the Expanding Universe

Lytleton and Bondi have recently developed a new theory to explain the expansion of the universe. Basically, the theory rests on the hypothesis that the magnitude of the charge of the proton exceeds that of the electron by about 2 parts in 10^{18} . Such a difference would mean that the smoothed-out background material of the universe would have a volume

charge sufficient to produce an electrical repulsion giving the observed expansion rate. The galaxies and clusters of galaxies occur in the theory as condensations in ionized regions, and take part in the expansion because they form and continue to grow from the dispersing background material, which is maintained at constant density by continual creation of matter.

The theory has other consequences. For example, potential differences of the order of 10^{19} volts occur between ionized units (galaxies and clusters), and the charge-excess is driven off from them as protons with energy of this order. In this way the theory may give a reasonable explanation of how these ultra-high energy cosmic rays are produced.

The charge-excess required by the theory could equally well result from a slight excess in the number of protons over electrons everywhere, with their charges exactly equal and opposite. In either form of the hypothesis, creation of matter implies creation of charge, and the Maxwell equations accordingly require a minute amendment involving cosmical terms.

If the proton and electron charge do differ slightly, very small particles of matter would necessarily have non-vanishing electric charge. No experiments made to date would have disclosed the requisite small charge difference, but it is just possible that tests could be devised that would do so, and establish how closely the two charges do in fact approximate to equality in magnitude.—*Research*, June 1959, 12, 240.

Emission of He I, $\lambda 10830$ in Solar Flare

The presence of the infra-red helium line $\lambda 10830$, in the Fraunhofer spectrum was first reported in 1934 by H. D. and H. W. Babcock. It appears to have its origin entirely in the chromosphere, and outside the solar limb it is seen in emission.

The emission of this line on the solar disc has been reported only once before in 1939, when it was seen over a solar eruption of intensity 3 that occurred near the centre of the disc on December 7, 1938.

It is well known that the D3 line of He I, $\lambda 5876$, appears in emission in solar flares. Since $\lambda 10830$ (2^3S-2^3P) and $\lambda 5876$ (2^3P-3^3D) belong to the same triplet series and share a

common level one would expect the former also to be seen in emission in flares. This has been observed and reported by E. Tandberg-Hanssen, W. Curtis and K. Watson in a recent issue of the *Astrophysical Journal* (1959, 129, 238).

On August 26, 1958, there was an outstanding solar flare rated at 3+, beginning 0005 U.T., maximum 0027, end 0124. The above authors report that observations of this flare were made at Climax Observatory and good spectra of the infra-red region were secured. The spectra show the $\lambda 10830$ line both in emission and absorption in a flaring region. The paper contains a first analysis of the emission profile with a calculation of the intensity ratio of the two components. The He I, $\lambda 10830$ is really a triplet with its bright two red components very close together at 10830.25 and 10830.34 (not resolved in the spectra) and the blue component at 10829.04 very weak.

The Vertebrate Ear

Even in its most highly evolved state the vertebrate ear is a dual—or even triple—purpose sense organ. It incorporates receptors for angular acceleration (semicircular canals), for linear acceleration including gravitational stimuli (otolith organs) and for oscillatory changes in linear acceleration such as vibration in general and sound in particular (otolith organs, cochlea). The vertebrate ear appears to be a phylogenetic novelty derived by modification from the lateral-line organs of early fish-like vertebrates and not from the statocyst of the invertebrates. Thus, the ear is probably not the comparative-anatomical homologue of the invertebrate statocyst. There is no doubt, however, that the two organs are functionally analogous.—Prof. O. Lowenstein at the Symposium on *The Ear Under Water*.

ERRATUM

Dr. N. K. Iyengar, the author of the article entitled "Applications of Electrophoresis Technique in Forensic Science," published in *Curr. Sci.*, 1959, 28, 316-19, writes that the following reference has been inadvertently omitted in his article. The same will read thus: (13) Goldbaum, R. and Williams, M. A., *J. Forensic Sciences*, 1959, 4, 144-52.

INTERNATIONAL CONFERENCE ON COSMIC RAY PHYSICS (MOSCOW, 1959)

THE biennial Cosmic Ray Conference organised by the International Union of Pure and Applied Physics was held in Moscow from 6th to 11th July, 1959; this was the first time that this Conference was held in the U.S.S.R. About 250 scientists from 25 countries including India participated; out of this about 175 were from the U.S.S.R. A total of about 175 original papers were presented under the following heads:

(i) Nuclear interactions at high energies. (ii) Extensive air showers. (iii) Experiments on the primary radiation using balloons, rockets and satellites. (iv) Cosmic ray intensity variations. (v) Origin of cosmic rays and related astrophysical aspects.

Plenary sessions were held in the mornings, at which the more important papers and papers covering the overall work of large groups were presented. In the afternoons two parallel sessions were usually held, where results of a more detailed nature were reported and discussed.

(i) Nuclear Interactions at High Energies:

It is clear that, for a very long time to come, nuclear interactions above 100 BeV will be studied by cosmic ray experiments alone. In order to investigate these, the so-called jets, with photographic emulsions, it is necessary to expose large stacks at high altitude for long periods of time; this is because the very high energy particles are extremely rare in the cosmic radiation. The cost of such a stack is enormous; for example, a stack one metre square and one mean free path deep costs about 15 lakhs of rupees. A further difficulty is the location of these jets. These difficulties are removed to a large extent through the use of "emulsion chambers" which are made up of layers of emulsion interleaved with thin plates of elements of high atomic weight, such as lead and tungsten. Such an assembly is not only very much cheaper than a similar stack of emulsion but also allows easy location of the jets by visual examination of the emulsions close to the lead or tungsten plates for high density electro-magnetic cascades. Such assemblies have been used on a small scale in the past; but recently the Japanese Co-operative emulsion group (Fujimoto, Nishimura and others) and the Bristol emulsion group (Fowler, Perkins and others) have used them on a large scale. The Bristol group have exposed an assembly of 1 cu. ft. in volume for 1,200 hours on high flying Comet aircraft. From a study of electro-magnetic cascades they find that the integral energy spectrum,

$N(>E) \propto 1/E^n$, for γ -ray energies between 10^{12} – 10^{13} ev, has an exponent $n = 3.5$; a similar exponent is found for γ -rays of similar energy arising from the decay of π^0 -mesons produced in nuclear interactions in the emulsion. The value of n for the primary radiation is known to be about 1.7. This observation, if confirmed, could mean that there is either a sharp cut-off of the primary energy spectrum at an energy of about 10^{15} ev./nucleon, or that the energy going into pions at these high energies is greatly reduced; this latter conclusion, taken with other evidence, would indicate appreciable production of particles other than pions at these energies. The Japanese group, using a similar arrangement at mountain altitude, obtain for γ -rays of energy between 10^{11} and 10^{12} ev. an exponent of 2.0. There is thus an indication at this stage that there is something new occurring in the range of primary energies which contribute to the production of photons of energy between 10^{12} and 10^{13} ev. Experiments using such chambers will be carried out extensively in the near future at mountain, airplane and balloon altitudes; the very heavy weight of these assemblies, about a ton, and the long exposures, of the order of days, put a considerable strain on balloon techniques.

A serious difficulty in these investigations is that there is no way, at the moment, of estimating the energy of the primary particles. A conventional method has been to derive the primary energy from the angular distribution of secondary relativistic particles; the basic assumptions underlying this have been questioned. A Russian group (Grigorev and others) have set up an "Ionisation Calorimeter" consisting of alternate layers of lead (or iron) and some particle detector such as ionisation chambers and photographic emulsions. The primary particle interacts in a layer of graphite above this assembly and the secondary particles travel through the calorimeter, in which they produce further interactions and the various particles lose energy in ionisation process. The total depth of the ionisation calorimeter is sufficient to ensure that all the energy brought by the primary particle and distributed to the secondary particles is expended in it in the form of ionisation; this represents a direct estimation of the primary energy, and the accuracy obtainable is $\sim 30\%$. Preliminary results obtained with this arrangement were reported.

A review talk was given by Feinberg on the present status of our theoretical understanding of phenomena at these energies. A number of interesting papers were also reported on the

analysis of high energy interactions, particularly on the existence of asymmetries in the angular distribution of secondary particles in the centre of mass system and its bearing on the question of the number of centres in the C.M. system from which the secondary particles are emitted.

(ii) *Extensive Air Showers:*

Results on extensive air showers (EAS) were presented by the large groups working at Moscow, M.I.T., Cornell and Tokyo. The role played by fluctuations in the interpretation of EAS was one of the main topics of discussion at the Conference. Basically, there are three types of fluctuations: (a) the primary particle may be a proton or a heavier nucleus with charge from 2 up to 26; (b) the level of the first collision will show considerable fluctuation with respect to the top of the atmosphere and (c) the characteristics of the various collisions in the atmosphere—the number of pions produced, their angular distribution, the inelasticities involved, etc.—and their energy dependence can cause considerable fluctuations. The Japanese group was strongly of the view that cause (b) was the main source of fluctuations. Experimental results on the fluctuations of core structure, energy flow, lateral distribution of particles and on the longitudinal development of the shower (by observations on the Cerenkov radiation produced in the atmosphere at different altitudes) were presented by the Russian group and the results on the fluctuations in the muon component of EAS by the Japanese group. The M.I.T. and the Cornell groups reported evidence for the existence of showers containing as many as 10^9 to 10^{10} particles, as also the more recent data for the number spectrum, absorption mean free path, etc. One of the more interesting observations is that of multiple penetrating showers observed in cloud chambers at mountain altitudes, as also that of a number of bunches of parallel penetrating particles deep underground; the mechanism responsible for the production of these is not yet clear.

(iii) *Experiments on the Primary Radiation Using Balloons, Rockets and Satellites:*

The most spectacular reports in this session relate to the existence of intense radiation zones surrounding the earth, the inner one extending from about 1,000 km. to 8,000 km. and the outer one from about 15,000 km. to 50,000 km. The properties of these zones, as derived from the limited number of observations made so far, are as follows:

(a) *The Inner Zone.*—The particles in the inner zone are electrons and protons. The

existence of protons in the zone is established by emulsion observations. The electrons are mainly of low energy; experiments with a magnetic spectrometer show that, between 30 KeV. and 4 MeV., 99% have energies less than 600 KeV. The integral range spectrum of the radiation falls by two orders of magnitude from 1 mg./cm.^2 to about 140 mg./cm.^2 —these are mainly electrons—then trails out more gradually towards greater stopping power. Of the radiation which penetrates 140 mg./cm.^2 a fraction of 1% penetrates several grams per square centimetre. The inner zone is relatively stable as a function of time. Protons and electrons arising from the decay of albedo neutrons and trapped in the earth's magnetic field could be an important input to the inner zone. That this can be so was demonstrated by the Argus experiment in which small yield atomic devices were exploded at high altitudes and the β -decay electrons from the fission fragments observed in the inner zone. Whether the albedo particles can explain the features of the inner zone quantitatively is not yet known.

(b) *The Outer Zone.*—It is now fairly well established that the overwhelming majority (> 98%) of particles in the outer zone are electrons. The energy spectrum apparently resembles that of the auroral soft radiation—rising sharply towards low energies from a practical upper limit of about 100 KeV. Further, the spectrum in the central region is softer than at the fringes, the effective energies being 25 KeV. in the central region and 50 KeV. at the fringes. Measurements with Pioneer IV (of 3 March, 1959) showed that the maximum intensity was much greater at that time than that observed with Pioneer III (of 7 December, 1958) and extended some 15,000 km. further out. This large temporal fluctuation provides the most important evidence for the solar origin of, at least, the outer zone; just prior to the Pioneer IV observations, there was a great M-region event on the sun (on February 25, 1959).

The interplanetary cosmic ray intensity has been estimated to be 0.18 ± 0.008 charged particles/cm.² sec. sterad. The photon intensity in the energy interval 45–450 KeV. is 3.0 ± 0.1 photons/cm.² sec. sterad; this is still subject to doubt.

(iv) *Cosmic Ray Intensity Variations:*

New information regarding cosmic ray intensity variations comes from the large amount of work done at various laboratories in connection with the I.G.Y. The most striking observation that has been made in this field is the high degree of correlation that is found

to exist between the cosmic ray intensity variations and solar flares, solar radio emission, radio fade outs and ionospheric disturbances, magnetic storms and auroral displays. This correlation has been established by the simultaneous observations on different geophysical phenomena during the I.G.Y. and since then. The time correlations observed are mostly interpreted in terms of solar corpuscular streams carrying frozen magnetic fields. The passage of the earth through these streams of ionized plasma and the consequent effects on the geomagnetic field at points away from the earth's surface is considered to be responsible for many of the observed effects.

An interesting observation by the Minnesota group might be mentioned here. They made a series of balloon ascents carrying photographic emulsions on receipt of information concerning enhanced solar activity (solar flare 3.4 on 10th May, 1959). On the initial ascents the emulsions showed a normal background of tracks and then in a flight a few hours later the emulsions recorded an enormous intensity of low energy (50-500 MeV.) proton tracks. The visual difference between this and the emulsion

exposed a few hours before was spectacular. The presence of the low energy particles was interpreted in terms of the distortion of the Stormer cut-offs by the solar stream—the arrival of which also produced strong auroræ, solar noise and a magnetic storm.

(v) *Theories of the Origin of Cosmic Radiation and Related Astrophysical Phenomena:*

No new theories on the origin of cosmic radiation were presented. An interesting review of this subject, particularly on the theory of the supernovæ origin of cosmic radiation, was presented by Ginsburg. As a result of radio-astronomical observations carried out during the last two years a number of the parameters needed to elaborate this theory are much better measured and understood. This appears to be the only real theory at the moment which has a quantitative basis.

The next Conference of this type will be held in Japan in 1961.

Tata Institute of Fundamental Research,	R. R. DANIEL.
Bombay-1.	M. G. K. MENON.
	B. V. SREEKANTAN.

IUTAM SYMPOSIUM ON THE 'THEORY OF THIN ELASTIC SHELLS'

A SYMPOSIUM on the theory of thin elastic shells, sponsored by the International Union of Theoretical and Applied Mechanics was held at Delft, Holland, under the Chairmanship of Prof. W. T. Koiter from August 24 to 28, 1959. Twenty-five invited research papers were read at the symposium.

Dr. C. B. Biezeno, Honorary Chairman of the symposium, gave a resume of the work done in shell theory and pointed out avenues which still remain to be explored.

The symposium mostly dealt with non-linear and axially asymmetric problems. W. T. Koiter showed that the assumptions of a plane stress permitted scientific classification of all linear theories. He pointed out that Love's first approximation for the strain energy as the sum of stretching energy and bending energy gave a consistent first approximation, both in the linear and the non-linear theories.

W. Zerna gave results by taking into account a non-linear stress-strain relation of the form proposed by Kauderer, while B. R. Seth showed that, by using finite components of strain and the strained state as a reference framework, a thin cylindrical shell could be deformed into a conical one by applying normal surface loads. W. A. Nash showed that Berger's method of neglecting the second invariant of the strain

energy gave good results for finite amplitude oscillations of rectangular plates and deflections of spherical shells. P. M. Naghdi showed that the problem of shallow shells reduced to a system of coupled non-linear partial differential equations involving the axial displacement and a stress function. With some approximation they reduced to the systems obtained by Grigolyuk and Reissner. Buckling of shallow spherical and conical shells was extensively discussed by B. Budiansky, P. Seide, N. J. Hoff and J. Singer.

J. W. Cohen and E. Reissner dealt with helicoidal shells. Cohen showed that the classical stress-strain relations were insufficient and that the consequent inconsistency in the stress calculations could be removed by slightly altering the equations of equilibrium. E. Reissner took into account the effects of transverse stress and normal stress deformation and found that the state of stress in such a shell could be split into two parts—one of inextensional bending and the other of membrane or moment-free state.

The symposium left open the question of what would constitute a comprehensive theory of thin shells. Most of the approximations made in existing literature were shown to be inconsistent with the order of approximation permitted in the problem.

B. R. SETH.

TAYLOR INSTABILITY AND THE DRIPPING OF LIQUIDS FROM HORIZONTAL SURFACES

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IT was proved by Taylor¹ in a classic way that when the interface between two perfect incompressible fluids is accelerated, the interfacial disturbances are stable when the acceleration is directed from the denser to the lighter fluid and unstable when the acceleration is from the lighter fluid into the denser one. This Taylor instability has become important in understanding some of the phenomena associated with cavitation nuclei²⁻⁴ and with the hitherto unsolved problem of interfacial disruption in emulsification.⁵

Bellman and Pennington,⁶ while discussing the effect of viscosity and surface tension on Taylor instability, have shown that the dripping of liquids from flat surfaces is also beautifully explained. (The compressibility of air can be neglected in this approximation, as will be seen.) Considering, say, water in a vessel with air above it, the system is put in equilibrium by an upward acceleration (to counter the natural gravitational acceleration). Since this acceleration is from the denser to the lighter fluid, the surface is stable. Considering the inverted system, say water hanging to the underside of a plate, the conditions favour instability and it is a familiar observation that the disturbances grow in amplitude leading to the dripping of water. Bellman and Pennington made the calculations for plane wave disturbances and they suggested that the axial symmetry will alter the numerical values. The present note confirms this conjecture. It may be mentioned that this problem occurs in the author's theory of emulsification also.

Consider the horizontal interface between two fluids, the lower one of density ρ_2 and the upper one of density ρ_1 ($\rho_2 > \rho_1$). Using cylindrical co-ordinates with the origin on the interface and the z -axis upwards, the linearized axisymmetric equations governing the fluids are

$$u_r = -\frac{\partial \phi}{\partial r}; u_z = -\frac{\partial \phi}{\partial z}; \frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial \phi}{\partial r} \right) + \frac{\partial^2 \phi}{\partial z^2} = 0 \quad (1)$$

$$\frac{\partial u_r}{\partial t} + \frac{1}{\rho} \frac{\partial p}{\partial r} = 0; \frac{\partial u_z}{\partial t} + g + \frac{1}{\rho} \frac{\partial p}{\partial z} = 0 \quad (2)$$

$$p = p_0 - g\rho z + \rho \frac{\partial \phi}{\partial t} \quad (3)$$

where g is the net acceleration (from ρ_2 to ρ_1) normal to the interface.

In order to satisfy the equations of motion and the Laplacian, the solutions are to be taken as

$$\phi_1 = A e^{-kz} f(t) J_0(kr);$$

$$p_1 = p_0 - g\rho_1 z + \rho_1 \frac{\partial \phi_1}{\partial t} \text{ in } \rho_1$$

$$\phi_2 = -A e^{kz} f(t) J_0(kr);$$

$$p_2 = p_0 - g\rho_2 z + \rho_2 \frac{\partial \phi_2}{\partial t} \text{ in } \rho_2$$

(4)

It is seen that the ϕ 's give zero velocities from the interface ($z = \pm \infty$ respectively) and also $u_1 = u_2$ at the (nearly plane) interface ($z \sim 0$). p is the mean pressure at the interface, the equation of which is $z = \xi(r, t)$ with axial symmetry.

Now at the interface

$$\frac{\partial \xi}{\partial t} = U_z = -\frac{\partial \phi}{\partial z} \Big|_{z=0} = k A f(t) J_0(kr)$$

and hence

$$\xi = k A J_0(kr) \int_{t_0}^t f(t) dt.$$

The other condition at the interface is the equality of the pressures p_1 and p_2 , which yields after a differentiation

$$g(\rho_2 - \rho_1) k f(t) + (\rho_2 + \rho_1) \frac{d^2 f}{dt^2} = 0 \quad (5)$$

The solution can be taken as $f(t) = \sinh nt$ since it gives the state of rest ($u=0$) at $t=0$. If n is imaginary or negative, the interface is stable, while a positive value of n leads to an exponential increase of the amplitude of the disturbances with time (other types of singularities can be present in special cases^{7,8}). From equation (5) one gets

$$n^2 = \frac{-g(\rho_2 - \rho_1)k}{(\rho_2 + \rho_1)}$$

and so

$$\xi = k A n^{-1} J_0(kr) \cosh nt.$$

Instability sets in when g is negative, i.e. the acceleration is from the lighter to the heavier fluid.

The interfacial tension T can be easily incorporated by writing the pressure condition at the interface as $p_2 - p_1 + T(R_1^{-1} + R_2^{-1}) = 0$. The principal curvatures of the surface (of revolution) are easily found to be $-k^2 A n^{-1} J_1(kr) \cosh nt$

and

$$k A n^{-1} [kr^{-1} J_1(kr) - k^2 J_0(kr)] \cosh nt$$

and so in the place of equation (5) one has

$$g(\rho_2 - \rho_1) k n^{-1} + (\rho_2 + \rho_1) n + T k^3 n^{-1} = 0$$

or

$$n^2 = \frac{[-g(\rho_2 - \rho_1)k - Tk^3]}{(\rho_2 + \rho_1)} \quad (8)$$

Equation (8) shows that even when g is negative, instability occurs only if

$$k < k_l = \left[\frac{-g(\rho_2 - \rho_1)}{T} \right]^{\frac{1}{3}} \quad (9)$$

Also, n has a maximum, at which the amplitude grows fastest, when

$$k = k_m = \left[\frac{-g(\rho_2 - \rho_1)}{3T} \right]^{\frac{1}{3}} \quad (10)$$

The relations (6-10) are seen to be the same as those in the case of plane disturbances^{6,9} $\zeta = \text{const.} (\cos. 2\pi x/\lambda) \cosh. nt$, except that k has replaced $2\pi/\lambda$. It appears probable that for arbitrary deformations of the interface, the conditions will be similar with suitable parameters replacing k .

Experiments on the dripping of water from the underside of glass plates show that dripping is a maximum when the "diameter" of the disturbance is $\sim 1.5\text{--}2.0$ cm., while no dripping occurs when this "diameter" is less than $\sim 1.0\text{--}1.5$ cm. (The amplitudes must be small. It can be shown^{10,5} that the spike of the heavier fluid will become narrower for larger amplitudes, in agreement with the familiar observa-

tions). The first root of $J_0(kr)$ occurs at $kr = 2.40$. So the limiting (lower limit) "radius" is $\sim 2.40 \times (70/980)^{\frac{1}{2}} \sim 0.6$ cm., while the most probable "radius" is $\sim 2.40 \times (3 \times 70/980)^{\frac{1}{2}} \sim 1.1$ cm. Of course, for detailed comparison, the exact mode of deformation must be observed and the theory must include the finite thickness of the liquid film.^{1,11} But the general physical situation is well understood now.

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LUNIK III—THE RUSSIAN THIRD MOON ROCKET

COINCIDING with the second anniversary of the launching of the first artificial earth satellite, Sputnik I, on October 4, 1957, Russia successfully launched her third cosmic rocket on October 4, 1959. The last stage of the rocket (weight, 1,553 kg. without fuel) on reaching the necessary speed, put into orbit an "automatic interplanetary station" which after circling the moon returned towards the earth and is now orbiting the earth.

The present moon flight is clearly a part of a well-defined programme of lunar interplanetary exploration and marks a considerable achievement in guidance and control techniques. Russia had previously launched two successful cosmic rockets; the first on January 2, 1959, which bypassed the moon and went into orbit round the sun (see *Curr. Sci.*, 1959, **28**, 47) and the second on September 12, 1959, which hit the moon (see *Curr. Sci.*, 1959, **28**, 359).

The placing of the automatic interplanetary station with the aid of a many-stage rocket, on a pre-selected trajectory has ensured its passage along a strictly defined course in relation to the moon, while at the same time ensuring its

maximum closeness to the moon. It thus became possible to make use of the moon's gravitational pull in such a way as to curve the further trajectory of the station's flight to ensure its return towards the earth over the northern hemisphere. The date for the flight around the moon was not selected without reason. On October 2-4 the moon was at the shortest distance from the earth, 363,000 km.

The "Station" itself weighs 278.5 kg. and is equipped with scientific instruments. The two transmitters working on 39.986 and 183.6 Mc/s. are powered by solar batteries. Information is being transmitted at definite intervals for about 2 hours a day, in conformity with the programme of observations. The operation of the equipment is being controlled from a co-ordination and computing centre on the earth.

It can be expected that Lunik III will yield much valuable scientific information on the nature of outer space, interplanetary matter, solar radiation and the nature of the Moon, especially the unseen side of it, which the "station" has photographed in its swing round the moon.

TRANSFORMATIONS OF 6-METHYLSALICYLIC ACID DERIVATIVES

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IN earlier publications^{1,2} relating to the biogenesis of lichen and mould products, it was indicated that a large number of these fall into the C_8 -unit (orsellinic unit) system. Attempts have also been made to derive them from acetic acid units.^{3,4} It has been shown that acetate as a nutrient in the growth medium could be utilized by moulds, and acetates may, therefore, play an important part in biogenesis. But, as a guide to the evolution of molecular architecture, the acetate hypothesis may not be so successful. The inherent difficulty is in the smallness of the unit as it is only next to the C_1 -unit. Larger units like C_5 , C_6 and C_8 provide definitely better indications. The contention of Robinson⁵ which is very significant in this connection may be quoted here. "There is no difficulty, for example, in adding atom to atom and thus arriving at any desired structure. In general the simple substances provide no useful comparisons, because the possibilities cannot be distinguished by inspection. On the other hand, the more complex molecules are much more revealing and a study of them soon leads to certain firm convictions. In this way a complex of interrelated ideas is formed and we can build on firmer ground." The significance of the C_8 -unit seems to be increasing because of newer discoveries. In our study of the C_8 -unit scheme, particular emphasis has been given to the gradual modifications that the C_8 -unit has undergone in various situations; these modifications involve reactions which can take place in the concerned structures with facility. In the present paper, the application of the C_8 -unit scheme of biogenesis is explained for the 6-methylsalicylic acid derivatives.

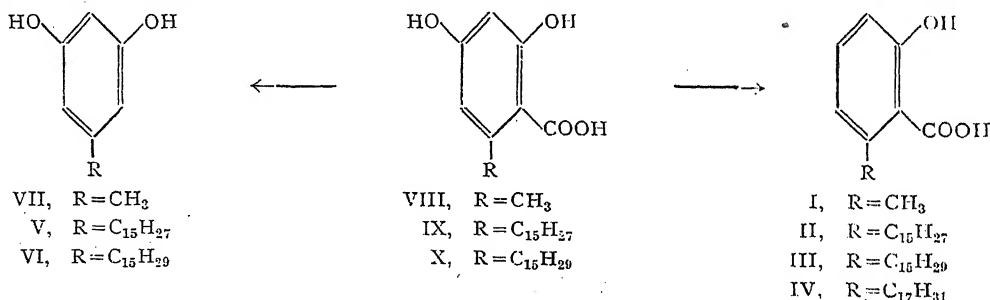
A. BENZENOID DERIVATIVES

(i) *Anacardic Acid Series*.—These constitute a group of natural products obtained from lacquer-producing plants and closely

related to 6-methylsalicylic acid (I). They are anacardic acid (II) (from *Anacardium occidentale*), ginkgolic acid (III) (from *Ginkgo biloba*) and pelandjaic acid (IV) (from *Pentaspadon* spp.).

The evolution of 6-methylsalicylic acid (I), a mould product, has already been discussed.^{2,6} It involves the loss of a hydroxyl group of the orsellinic acid (C_8 -) unit. The lengthening of the methyl side chain in the 6-position of the C_8 -unit by addition of even number of carbon atoms was originally shown to be a common feature in lichen depsides and depsidones¹ and more recently recognized in the benzoquinone series.⁷ The above three acids (II, III & IV), which are chain-lengthened analogues of 6-methylsalicylic acid, should have a similar origin. This explanation of the biogenetic relationship receives support from the occurrence in the same sources of orcinol derivatives with lengthened side chains. They are cardol (V) (in *Anacardium occidentale*) and bilobol (VI) (in *Ginkgo biloba*). Orcinol (VII) itself has long been known as a lichen product (e.g., *Roccella montagnei*⁸), produced by facile decarboxylation of orsellinic acid (C_8 -unit, VIII). Cardol (V) and bilobol (VI) should be considered to be similar decarboxylation products of the corresponding carboxylic acids (IX & X). Thus from a common orsellinic acid type both the anacardic acid and the cardol groups of compounds can be derived.

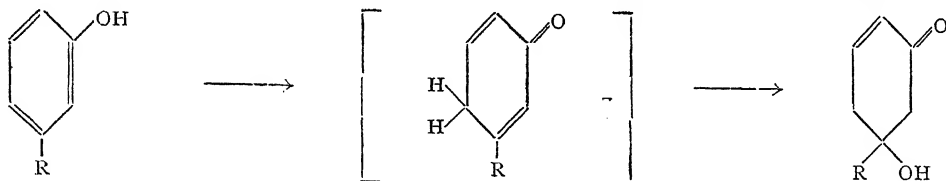
(ii) *m-Cresol Derivatives*.—Members of the cardanol series (XI a) (from *Anacardium occidentale*) and camptospermonol (XI b) (from *Camptosperma* spp.) are also related to 6-methylsalicylic acid analogues as decarboxylation products. The presence of the carbonyl group in the β -position of the side chain in camptospermonol (XI b) is what one meets



with in the lichen acid series also (e.g., physodic acid).

Camptospermonol (XI b) is found to be accompanied by an optically active long chain compound⁹ (XII) which is a derivative of

are derivatives of catechol with long chains in the 3-position. It has been shown in the lichen acid series that a hydroxyl is frequently found in the same place as an aldehyde. A similar feature could be expected in the 6-



XI a, R = C₁₅H₃₁; C₁₅H₂₉; C₁₅H₂₇; C₁₅H₂₅

XI b, R = CH₂COC₁₇H₃₃

XII

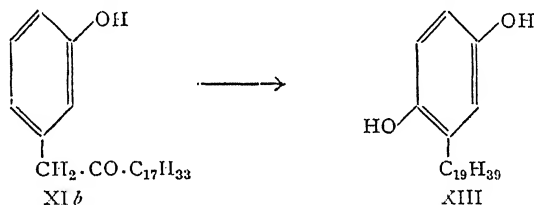
cyclohexenone. Their relationship is easy to discern. It is one of hydration and dehydration. But how hydration takes place in the aromatic unit is not clear and does not seem to have known biochemical analogies. A possible course of the reaction is indicated above.

(iii) *Quinol Derivatives*.—Another compound occurring along with camptospermonol (XI) is a long chain quinol (XIII) which has

methysalicylic series also and hence these catechols could be considered to arise from the corresponding salicylaldehyde derivatives (XVII) by an oxidation process involving peroxide.

B. COMPOUNDS DERIVED BY RING FISSION

All the above-mentioned compounds arise by modifications of the C₈-unit in which the benzene ring is in tact and the original skeleton could be fairly easily discerned by inspection. Ring fission seems to be involved in a number



XI b

XIII

recently been isolated from the oil of *Camptosperma auriculata*.¹⁰ Its relationship to camptospermonol (XI) is simple and its biogenesis should involve an extra step of *para*

of mould products; hence in these cases the relationship to the original C₈-unit is not so obvious and has to be understood by careful scrutiny and analysis of the structures.



XVII

XIV, R = C₁₅H₃₁, C₁₅H₂₉, C₁₅H₂₇, C₁₅H₂₅

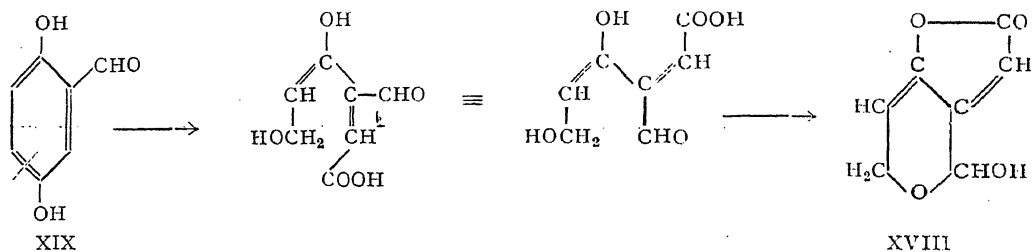
XV, R = C₁₇H₃₃

XVI, R = C₁₇H₃₁

nuclear oxidation besides reduction of the side chain.

(iv) *Catechol Derivatives*.—There seems to be a group of compounds which are not directly related to 6-methylsalicylic acid but to the corresponding aldehyde as the C₈-unit. The members of the urushiol series (XIV) (from *Rhus* spp.), glutarenghol (XV) (from *Gluta renghas*) and laccol (XVI) (from *Rhus* spp.)

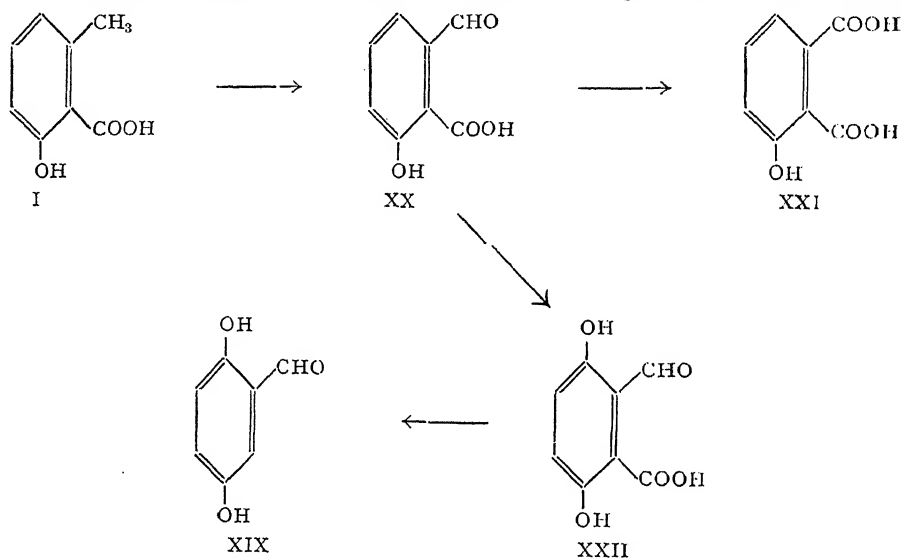
Patulin (XVIII) is an antibiotic substance of comparatively small dimensions and its constitution was finally established by Woodward and Singh.¹¹ Based on the co-occurrence of gentisyl alcohol, gentisic acid and patulin in the metabolic products of *Penicillium patulum*, Birkinshaw¹² suggested that gentisic aldehyde (XIX) was the precursor of patulin (XVIII). The stages involved are oxidative ring opening and



subsequent ring closure of the lactone and hemiacetal rings.

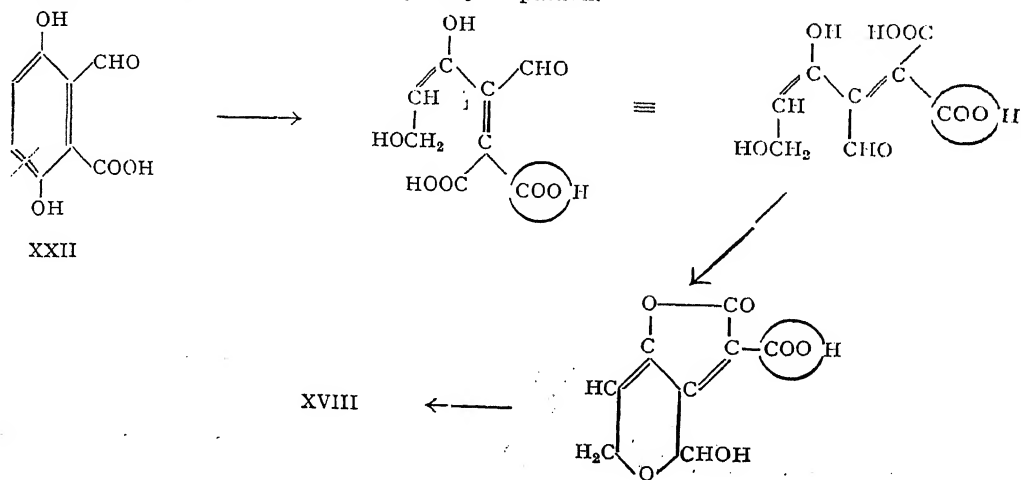
Later, Ehrensvärd¹³ isolated 6-methylsalicylic acid (I) as a metabolic product of *P. patulum*.

phthalic acid (XXI) as additional products from *P. patulum* besides the earlier reported substances. They suggested that the intermediate (XXII), though not so far isolated as a



However, he felt that it was not directly related to patulin but was the product of a side reaction. Recently, Bassett and Tanenbaum¹⁴ have obtained gentisic aldehyde (XIX), 6-formylsalicylic acid (XX) and 3-hydroxy-

natural product, would explain the direct biogenetic relationship between 6-methylsalicylic acid (I) and gentisic aldehyde (XIX) which has been suggested to be the precursor of patulin.¹²



The above suggestion is supported by the work of Bu'Lock and Ryan¹⁵ who used labelled 6-methylsalicylic acid¹⁶ as a nutrient of *P. patulum* and isolated labelled patulin with the activity in the expected positions according to the above scheme of biogenesis. However, it is possible that patulin (XVIII) could be derived from the intermediate (XXII) itself as follows instead of passing through the gentisic aldehyde (XIX) as a further intermediate; the decarboxylation may take place at an undetermined stage.

SUMMARY

Members of the anacardic acid series and the accompanying orcinol derivatives are derived from orsellinic acids (C_8 -compounds) with lengthened side chains. *m*-Cresol derivatives are related to the anacardic acid series by a stage of decarboxylation and quinol derivatives by an extra stage of nuclear oxidation. Hydration of *m*-cresols also seems to be possible. Catechol derivatives with long side chains are derived from the corresponding aldehydes involving a stage of oxidation. Patulin is a typical example of a product obtained by ring fission from 6-methylsalicylic acid.

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* The following are recent additions to natural benzoquinones and related compounds: (i) solanachromene (Rowland, R. L., *J. Amer. Chem. Soc.*, 1958, 80, 6130); (ii) the corresponding plant quinone (Kofler, M., *et al.*, *Helv. Chim. Acta*, 1959, 42, 1283; Trenner, N. R., *et al.*, *J. Amer. Chem. Soc.*, 1959, 81, 2026) and (iii) ubichromenol (Leidman, D. L., *et al.*, *Chem. and Ind.*, 1959, 1019).

NOBEL PRIZE IN MEDICINE

DR. SEVERO OCHOA and Dr. Kornberg, both of the United States, have been awarded the Nobel Prize in Medicine for 1959, for their discoveries of the mechanism in the biological synthesis of the Ribonucleic Acid and Deoxyribonucleic Acid.

The nucleic acids are present both in the nuclei and in the protoplasm of living cells and they are intimately connected with cell division, mutation and the manufacture of enzymes. The ribonucleic acid (RNA) takes part in the production of proteins whereas the deoxyribonucleic acid (DNA) is present in the chromosomes as carrier of the hereditary qualities.

Dr. Ochoa was born in Lueca, Spain, in 1905 and qualified at Madrid University. In 1937

he worked in the Marine Biological Institute at Plymouth, England, and later was Nuffield Research Assistant in Biochemistry at the Oxford University Medical School. He came to the United States in 1940, and has been Professor of Biochemistry since 1954, at the New York College of Medicine. He has written a number of works on the biochemistry of muscles and of the brain.

Dr. Kornberg was born in 1918 in Brooklyn, New York, and received his M.D. at Rochester University. Until 1952 he was attached to the National Institute of Health, and later was Professor of Microbiology at the University of Washington. He is now Professor of Biochemistry at Stanford University, California.

INTERNATIONAL OCEANOGRAPHIC CONGRESS

THE First International Oceanographic Congress which drew over 1,100 scientists from some 45 nations ended its two-week session at United Nations Headquarters in New York, on September 12, 1959.

During the meeting plans for a major international research project in the Indian Ocean were announced by (International Council of Scientific Union) ICSU's Special Committee on Oceanic Research for the years 1960-64. This plan, somewhat on the model of the International Geophysical Year, provides for a thorough, co-ordinated study of the Indian Ocean by an international fleet of research vessels.

The Indian Ocean is of special scientific interest because twice a year the monsoons reverse its ocean currents and thus shift the locations of the up-swelling waters from below that are rich in the basic materials for the nutrition of fish. In addition, the ocean is thought to be crossed by a submerged mountain ridge that curves from below the tip of Africa to the Pacific, passing between Australia and Antarctica but branching to send a ridge also northward to the Red Sea.

Another project outlined during the Congress may help to answer questions on the age of the earth's crust and the original formation of the oceans. The proposal is to bore a hole all the way through the crust of the earth, where it is thinnest at the sea bottom, about 18,000 ft. below sea level, down to a depth of 31,000 ft. where the lighter crystal rocks and the earth's "mantle" begins.

A third important development was to call for a world-wide study of the radioactivity of the ocean waters to determine the effect of the submarine disposal of radio-waste products from nuclear reactors and the laboratories. A further recommendation was that the International Atomic Energy Agency in Vienna carry out a study of the maximum permissible concentration of oceanic radioactivity. There is no notable contamination of the ocean as yet, but the increasing number of nuclear power plants make these preparations advisable, in the opinion of the committee.

Among other topics—and there were many—that aroused special interest at the Congress are the following:

(i) The probability that life did not originate in the sea itself but on the under-water clay

surfaces in estuaries and shallow bays where "chemical evolution" took place for hundreds of millions of years at a time when the atmosphere was poor in oxygen but rich in hydrocarbons and perhaps ammonia. Increasingly complex organic molecules were formed by contact in concentrated layers absorbed in the clay until amino-acids resulted. These then combined to give proteins which were able to duplicate their own molecules. After that, organization of the proteins into cells became possible and biological evolution could begin. The oxygen in today's atmosphere would prevent such chemical evolution but the same process may well occur on the astronomical number of planets that may belong to stars other than the sun.

(ii) The earliest fossils found anywhere show that evolution must already have been going on for long periods of time without leaving a trace. The explanation of this is that the earliest animals were plant-eaters with soft bodies; it was the much later appearance of carnivorous animals that forced the protective development of shells and skeletons which form fossils.

(iii) The discovery that the relatively rich life in the ocean near the Equator, where the upward currents bring nutrients, resulted in the formation of a continuous band of sediments around the earth which indicates that the Equator has been where it is now for some 500 million years. Consequently the poles have not wandered about and some explanation is needed for glacial periods.

(iv) The indication that the chemical composition of the sea has not changed for some 250 million years, that the ocean has not become more salty and that therefore the salt in the ocean has not come from washing out the continents by rivers but must have some other unknown origin.

(v) Sea plants and animals produce a wide variety of special chemical substances such as vitamins, antibiotics, growth stimulants and hormones which may themselves be valuable to man and which, with further study, could explain the occasional explosive growth of some varieties and also the catastrophic death of millions of tons of fish, apparently by disease at some times and places.—UNESCO.

LETTERS TO THE EDITOR

EFFECT OF CONVERSION OF MATTER INTO RADIATION ON THE CURVATURE OF AN EXPANDING UNIVERSE

FOLLOWING a method initiated by Vaidya,¹ Raychaudhuri² first considered the case of a mass particle being completely annihilated and converted into radiation. He found that such a process could not be adequately described by the field equations of relativity. However, Israel³ found that the relativity equations are adequate to describe such a process of complete conversion of a mass particle into radiation and he has given a model for the same.

In all these attempts, the mass particle was embedded in a Schwarzschild space-time and after conversion into radiation, the hollow created was empty (flat). It would be of interest to see how these conclusions are modified when the same process is studied not in the flat background, but in the background of a homogeneous universe.

Beginning with the static spherical Einstein universe given by

$ds^2 = -R^2 [d\chi^2 + \sin^2\chi (d\theta^2 + \sin^2\theta d\phi^2)] + dt^2$ (1)
we can choose a convenient radial co-ordinate x by the substitution $x = R \tan \chi$. Then (1) reduces to

$$ds^2 = - \frac{1}{(1 + x^2/R^2)^2} dx^2 - \frac{x^2}{(1 + x^2/R^2)} (d\theta^2 + \sin^2\theta d\phi^2) + dt^2. \quad (2)$$

The advantage of this particular choice of radial co-ordinate is two-fold: (i) The boundary radius R of the universe is reached in (1) at $\chi = \pi/2$ and therefore in (2) at $x \rightarrow \infty$. (ii) Closed as well as open non-static models can be discussed by a simple generalization of (2).

At $t = 0$, a particle at the origin starts emitting radiation. At $t = t_1$, the last material speck in the particle is converted into radiation. Then at any later time t we have a shell of radiation moving outwards from the origin.

On the outside of the shell is the static Einstein space-time, while on the innerside we can have some other cosmological space-time. It is found that the O'Brien and Synge⁴ jump conditions at the two boundaries require that (i) the shell cannot be occupied by pure moving radiation only but should be occupied by a mixture of moving radiation and matter of non-

zero density,⁵ (ii) the pressure and density of matter within the shell pass over continuously at the two boundaries of the shell to the pressure and density of cosmic fluids on the two sides. (iii) we cannot have flat space-time on either side of the shell, and (iv) the curvature $1/R^2$ of the inner cosmic space is less than that of the outer one.

We have worked out a rigorous solution of the field equations of relativity which gives the gravitational field within the shell as described above. The line-element is

$$ds^2 = - \frac{\gamma^2}{x^2} \frac{1}{1 + Px + Qx^2} dx^2 - \gamma^2 (d\theta^2 + \sin^2\theta d\phi^2) + \frac{x^2}{\gamma^2} \frac{1}{1 + Px + Qx^2} dt^2 \quad (3)$$

with

$$\gamma^2 = e^{\psi(t)} \{B + A\phi(t)\}^2 x^2.$$

Here P , Q , A and B are conserved functions along the world lines of flow of radiation with two relations between them.

At any time t , we take two null-surfaces $x = X_1(t)$ and $x = X_0(t)$, $X_1(t) > X_0(t)$. If we fit this solution with the Einstein static universe at $x = X_1(t)$ and with the expanding closed cosmic space-time at $x = X_0(t)$ satisfying all the necessary equations of fit, we can draw the conclusions as stated above. It is further found that by the time the surface $x = X_1(t)$ reaches the boundary of the Einstein static model, the other wavefront $x = X_0(t)$ also reaches the same boundary and thus the radiation shell vanishes over a sphere of discontinuity of the Synge⁶ type which has receded to infinity and the observable universe round the origin is the expanding cosmic model given by

$$ds^2 = - e^{\eta(t)} \left[\frac{1}{(1 + x^2/R^2)^2} dx^2 + \frac{x^2}{(1 + x^2/R^2)} (d\theta^2 + \sin^2\theta d\phi^2) \right] + e^{-\eta(t)} dt^2 \quad (4)$$

where

$$\frac{1}{R^2} < \frac{1}{R^2}.$$

Thus the effect of an explosion converting a material particle completely into radiation is to reduce the curvature of the universe. One can say that against a disturbance of this type a homogeneous universe of smaller curvature is more stable than one of larger curvature. Also by considering the accumulated effects of

a series of such conversions one can conclude that ultimately the observable universe round an observer will tend to become open with zero curvature.

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RADIOCHROMATOGRAPHY OF ALKALI EARTH IONS

In an earlier investigation, acid-washed asbestos paper was used with success in the chromatographic separation of the alkali ions, Li^+ , Na^+ , K^+ , Rb^+ and Cs^+ with dilute hydrochloric acid as solvent.^{1,2} By a comparison of these results with those observed on Whatman filter-paper No. 1 impregnated with the resin Dowex-50, it was concluded that asbestos functions as a natural inorganic ion exchanger of capacity of the order of about 30 microequivalents per cm^2 of the paper, weighing on the average 30 mg.³

We have now extended the above method to a separation of the alkali earth ions, Ba^{++} and Sr^{++} labelled with their radioisotopes Ba^{133} and Sr^{90} . The former was obtained by a four-week irradiation of BaCO_3 by thermal neutrons in one of the nuclear reactors of Harwell, while the latter radioisotope Sr^{90} , in equilibrium with the daughter radioelement Y^{90} , was provided by the Radiochemical Centre, Amersham. Bands of asbestos paper, $35 \times 10 \text{ cm}$, were cut out of 0.2 mm. thick sheets washed with concentrated hydrochloric and nitric acids following the procedure reported earlier.¹ A mixture of Ba^{133} and Sr^{90} (+ Y^{90}) was spotted with about 2-3 mg. of the carrier elements in the form of chlorides along a line 5 cm. from one end of the above asbestos band. The chromatography was by ascending development using 0.1 N hydrochloric acid as solvent. When the development was complete, the band was dried and cut into a series of samples of 5 mm. width along the entire length from the origin to the front of the solvent. A specially

shielded end-window GM counter giving a background of 12 counts/min. was used to determine the *r partition* of radioactivity in the chromatogram, as a function of distance from the origin. Figure 1 shows the resulting separation of Ba, Sr and Y.

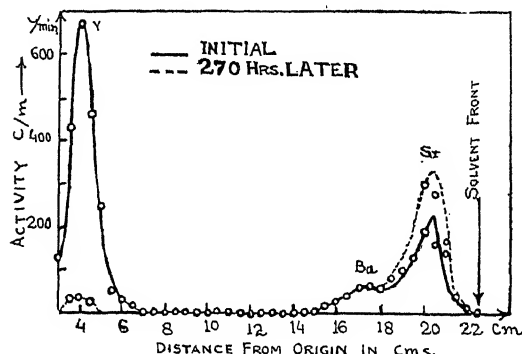


FIG. 1. Radiochromatogram of Ba, Sr and Y on acid washed asbestos paper and 0.1 N HCl as solvent.

Decay characteristics of Ba^{133} , Sr^{90} and Y^{90} were used in, distinguishing their positions in the chromatogram. Ba^{133} decays by K-capture with a period of >20 years. The product Cs^{133} is stable. Sr^{90} is a β^- emitter with a period of 19.9 years. The daughter element Y^{90} also decays by β^- emission but with a period of 65 hours, the final product being stable Zr^{90} . A study of the time variation of the activities of these samples, initially separated, suffices to identify them. The activity of the peak corresponding to Y^{90} decays to nearly zero in about 2 weeks' time, while that of Sr^{90} grows to a constant maximum in the same time, the activity of the equilibrium mixture ($\text{Sr} + \text{Y}$) being double that of the initial parent element alone. Lastly, the activity corresponding to the Ba^{133} peak remains sensibly constant for periods of the above order. The curve shown by the dotted line in Fig. 1 shows the distribution of the activities in the chromatogram measured 270 hours after the initial distribution shown by the full curve had been recorded. Following are the R_f values for the chromatographic separation obtained:

$$Y : 0.18, \quad Ba : 0.76, \quad Sr : 0.90.$$

The above separation of the alkali earth ion on asbestos paper, with but dilute hydrochloric acid as solvent lends further support to our earlier conclusion, based on the chromatography of alkali ions,¹² that asbestos functions as a natural ion exchanger. Incidentally, because of the large difference in the associated R_f values the method serves as a simple means of obtaining carrier-free Y^{90} from its equilibrium mixture

with Sr^{90} , an important fission product, without recourse to column chromatography employing synthetic ion exchanger resins and complex solvent mixtures. Further work on the separation of Ca, Sr and Ba is in progress.

Our grateful thanks are due to Prof. S. S. Joshi for his guidance and help.

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THE PREPARATION OF ANHYDROUS URANIUM TETRAFLUORIDE

The strong binding of the molecule of water to that of uranium tetrafluoride always leads to the formation of the compound $\text{UF}_4 \cdot \text{H}_2\text{O}$, whenever water is present either in the reagents, or is formed in the reaction process. Our attempts to prepare anhydrous tetrafluoride by the reaction of aqueous HF with uranium (IV) oxyformate¹ and oxyacetate² resulted in the formation of the hydrated compound. Even when the hydrated ammonium uranium fluoride complex, $\text{NH}_4\text{F} \cdot \text{UF}_4 \cdot \text{H}_2\text{O}$, was heated in vacuum the monohydrate tetrafluoride was obtained. Decomposition of the hydrated product occurs as indicated by the appearance of the black colour, if heating of the hydrated compound is continued at high temperature in vacuum. But when hydrated tetrafluoride is treated with HF at high temperature,³ the partially decomposed product, formed in the process of removal of water, is simultaneously converted back to tetrafluoride. The non-existence of water automatically excludes any possibility of association with water when the product is cooled.

Anhydrous uranium (IV) tetra-acetate $\text{U}(\text{CH}_3\text{COO})_4$ and ammonium bifluoride $\text{NH}_4\text{F} \cdot \text{HF}$ were chosen as the starting materials as none of them contain water or produce it when reaction occurs. When an intimate mixture of the two was heated in vacuum, the anhydrous complex $\text{NH}_4\text{F} \cdot \text{UF}_4$ was obtained (*loc. cit.*). The thermal decomposition of the anhydrous complex in vacuum at about 450° gives the anhydrous tetrafluoride. The extremely hygroscopic nature of the ammonium complex necessitates the precautions for avoiding exposure to moisture. The analyses carried out by the method reported earlier (*loc. cit.*),

as recorded in Table I, show that the compound obtained is anhydrous tetrafluoride.

TABLE I
Estimation of Uranium as U_3O_8 and
Fluoride as CaF_2
Weights in mg.

Compound taken	U_3O_8		CaF_2	
	Calcd.	Found	Calcd.	Found
116.6	104.3	104.0	57.9	57.2
123.0	109.9	109.0	61.5	61.2
199.0	177.8	176.2	98.9	98.6
224.0	200.2	198.0	111.0	110.6

The method described above does not include the high temperature treatment of HF^5 or freons^{6,7} and thus provides an alternative method for the preparation of anhydrous uranium tetrafluoride.

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FREE AMINO-ACIDS IN THE BLOOD OF SOME VERTEBRATES

The blood of vertebrates as well as of invertebrates has been studied extensively in recent times.²⁻⁶ However, free amino-acids of the vertebrate blood have not been studied, even though Paper Chromatography provides an excellent technique for such an investigation. In this note we are reporting the qualitative and semi-quantitative distribution of free amino-acids in the blood of frog (*Rana tigrina*), pigeon (*Columba livia*), fowl (*Gallus domesticus*) and bandicoot (*Bandicota indica*).

For the detection of free amino-acids, blood was first pipetted into three times its volume of absolute alcohol to precipitate the proteins.

After centrifuging, the protein-free alcoholic extract was mixed with three times its volume of chloroform. The aqueous layer formed on top of the chloroform-alcohol mixture was used for chromatographic separation of free amino-acids. Free amino-acids were studied by circular as well as two dimensional chromatography. Butanol-acetic acid-water (4:1:5) was used as the solvent for circular, and secondary Butanol-formic acid (80%)-water (30:4:6) and 80% phenol for the first and second runs respectively for two-dimensional chromatography. Results are given in Table I.

TABLE I

Free amino-acids and related compounds in the blood of some vertebrates

	Frog	Pigeon	Fowl	Bandicoot
Aspartic acid	.. ++	+½	+½	+
Glutamic acid	.. +++	+++	++½	+½
Alanine	.. +	++	++½	+++
Arginine	.. +	Trace	+½	++
Cystine	.. +++	+++	+++	++
Glycine	.. +	++	+	+
Histidine	.. +	+	+	++
Leucine-Isoleucine	+½	+	+	+
Lysine	.. +½	Trace	Trace	Trace
Methionine	.. ++	--	--	--
Phenylalanine	.. +	Trace	Trace	+
Proline	.. Trace	--	--	--
Serine	.. +	+	++	+
Threonine	.. ++	Trace	+	+½
Tryptophane	.. +	--	--	+
Tyrosine	.. +	+	Trace	+
Valine	.. ++	--	--	--
Taurine	.. +	+++	+++	++
Glutamine	.. +	++	++	++

+++ = Very prominent; ++ = Prominent; + = Present; -- = Absent.

An examination of the results shows that 19 free amino-acids are present in the blood of frog, 16 in bandicoot and 15 in pigeon and fowl. Of the essential amino-acids, leucine, isoleucine, lysine, phenylalanine and threonine are present in all. But methionine and valine are present only in frog, and tryptophane is present in frog and bandicoot. Of the sulphur containing amino-acids, cystine is present in all, in more or less the same concentration but methionine is found only in frog. It is interesting to note that a number of non-essential amino-acids is present in appreciable quantities in all the four animals examined. This is not surpris-

ing as they are known to contribute towards essential physiological functions.

Comparing the results with those of invertebrates like *Panulirus*, *Scylla* and *Telescopium*? it is seen that there are more free amino-acids in the vertebrate blood than in invertebrates. Glycine, serine, arginine, histidine, lysine, alanine, glutamic acid and threonine have been reported in the blood of *Panulirus*. All these except glutamic acid, threonine and proline are present in *Scylla* while all listed for *Panulirus* except glutamic acid and alanine, and in addition leucine, methionine and valine are present in *Telescopium*.? This may mean that the amino-acid requirements of invertebrates are much less than those of vertebrates or perhaps they can synthesize their requirements to a much greater extent than vertebrates. It is now well established that the amino-acid nitrogen content of plasma in insects is very high. The nature of the amino-acids found in the internal medium of insects is still insufficiently known. In *Dytiscus*, for example, the search for arginine, tryptophane, phenylalanine or cystine gave negative results. The plasma concentration of histidine is about 30 mg.% and of tyrosine 117 to 168 mg.% (106 mg.% of total amino-nitrogen in plasma).¹ The amounts of these two amino-acids are very high as compared with other animals. The nature of the largest portion of amino-acids in the blood plasma of insects is still undetermined. In the absence of such information comparison with the present results is not possible.

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A NEW TURBIDIMETRIC METHOD FOR THE DETERMINATION OF THALLIUM (I)

BECAUSE of the extreme toxicity of thallous salts it is often necessary to detect and determine thallium in microquantities. Of the various methods adopted for its estimation, the colorimetric procedures depend essentially on the complexes formed by thallium with organic and inorganic reagents.^{1,2} The oxidation of

thallium (I) by selenious acid and the quantitative aspect of this reaction have been reported earlier from these laboratories.³ The formation of the red sol of selenium in this reaction has now been utilised for the turbidimetric determination of thallium.

In the present procedure, aliquots of selenious acid were mixed with varying amounts of thalious solution and the acidity was raised to 4-6 N with hydrochloric acid. 5 ml. of 1% solution of gelatine was added as stabilizer and the volume was made up to 10 ml. Extinction readings, with 5 ml. of the mixture, were taken with the Hilger Spekker absorptiometer model H 760, using one of the three filters, greenish-blue, bluish-green or green having a total transmission range of 490-550 m μ . These readings were found to be linearly proportional to the concentration of thallium in the range 10 to 100 p.p.m. From a standard curve, as little as 1 to 2 p.p.m. of thallium in an unknown sample, could be determined with a maximum error of about 2%. It was necessary to add an excess of Se^{iv} to ensure complete oxidation of Tl (I) to Tl (III). After an equivalent of Se was formed there was no change in the absorption of the sol with more addition of selenious acid indicating the absence of Thallium (I) in the solution.

In the study of the effect of varying acid concentration, on the reaction, it was observed that for the solutions of selenite and thallium (I) in the concentration range 0.1 M to 0.001 M, the required overall normality of HCl for the full development of the red turbidity was about 4-6 N. At a lower normality thalious chloride precipitated and at a higher acid concentration the suspension of metallic selenium tended to go into solution.

At room temperatures, the complete formation of the red sol required about half a minute after the mixing of selenium and thallium solutions, while at an elevated temperature ($\approx 50^\circ\text{C}$.) the colloidal suspension appeared instantaneously. The intensity of the colour, which probably depended upon the size of the particles, was almost the same within a temperature range of 40-60 $^\circ\text{C}$. However, the colour of the sol varied from yellowish red (between 20 $^\circ\text{C}$. to 40 $^\circ\text{C}$.) to pink violet (60 $^\circ\text{C}$. to 80 $^\circ\text{C}$.).

It was also observed that foreign ions, excepting those of the strong oxidising and reducing agents, had little influence on this reaction.

The reaction is quantitative and may also be used for the determination of selenium when it is necessary to add an excess of thallium (I)

solution to Se^{iv}. The method is simple, easily workable and sufficiently accurate.

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THERMAL STABILITY OF ALLINASE- AND ENZYMATIC REGENERATION OF FLAVOUR IN ODOURLESS GARLIC POWDER

It is known that garlic in its natural condition does not exhibit any flavour, but as soon as it is injured, peeled or macerated, a very strong garlic odour develops due to the enzymatic cleavage of *allin* into *allicin*, the chemistry of which has already been discussed elsewhere.¹ The enzyme *allinase* involved in this process is sensitive to heat and has been reported to be inactivated on steam bath in 30 minutes.² Besides, Stoll and Seebeck² have studied some properties of allinase with respect to time, temperature, pH, organic solvents and storage stability, etc., but have not indicated the minimum time for the inactivation of allinase in boiling water. In order to study the thermal stability of allinase, some lots of fresh garlic cloves were blanched in boiling water for 2.5, 5, 7.5, 10, 12.5, 15 and 20 minutes respectively and immediately analysed for their antibacterial potency, by the cup plate method.^{3,4} None of the such treated samples showed any antibacterial activity (A.B.A.), indicating inactivation of allinase even at 2.5 minutes' blanching.

A bigger batch of odourless garlic powder was then prepared from a 4 lb. lot of fresh garlic after blanching it for 5 minutes (to ensure complete inactivation of the allinase) before giving the usual mechanical treatment⁵ prior to dehydration and was analysed for allyl sulphide,^{6,7} antibacterial activity,^{3,4} colour and flavour and the results (Table I) compared with the control (without blanching). The A.B.A. and flavour in the powder prepared from the blanched garlic was almost completely destroyed,

thus confirming the inactivation of allinase within 5 minutes of blanching in boiling water. The colour of the finished product was more white than that of the control sample. This may probably be due to the inactivation of other enzymes like peroxidase and catalase. Qualitative tests for both these enzymes gave negative results.

TABLE I

Effect of blanching on the quality of garlic powder

Treatment	Moisture	% Allyl sulphide F.W.B.	A.B.A. (mm.)	Colour (Tintometer Units)	
				R	Y
Control ..	7.0	0.33	10	1.4	2.2
Blanched in boiling water for 5 minutes	7.1	0.22	Nil	1.1	1.1

Most of the vegetables, before their dehydration, are steam or water-blanching in order to check the undesirable changes in colour and flavour, etc. But the above results (Table I) indicate that blanching is quite unsuitable for dehydration of garlic as garlic powder is valued more for its flavour than colour. However, from the pharmaceutical angle, blanching helps in the preparation of odourless garlic powder in which the active antibiotic—allicin and flavour can be regenerated at will by incorporation of suitable enzymatic extracts as demonstrated below:

ENZYMATIC REGENERATION OF FLAVOUR IN ODOURLESS GARLIC POWDER

The odourless garlic powder prepared as above was treated with crude enzyme (allinase) solution prepared from fresh garlic by the method of Stoll and Seebeck.² Three narrow sample-tubes containing (i) Starch + Enzyme extract, (ii) Odourless garlic powder + Enzyme extract, (iii) Odourless powder + distilled water equivalent to the enzyme extract were evaluated for allicin,⁸ allyl sulphide, A.B.A. and overall flavour.

The results (Table II) clearly indicate the cleavage of allin (which could not be split up earlier and was lying dormant as a potential source of flavour) into allicin. The value of allicin which is only 539.9 mg./kg. in odourless powder (lot I) is increased to 2,537 mg./kg. and allyl sulphide content increased from 0.22% to 0.395% (corrected for corresponding values for the enzyme extract alone). The antibacterial activity was also reactivated on addition of the

TABLE II

Enzymatic regeneration of flavour in odourless garlic powder

Sl. No.	Treatment	Allicin mg./kg.	Allyl Sulphide %	A.B.A. (mm.)	Flavour
I	Odourless garlic powder	.. 539.9	0.22	Nil	Poor
II	Odourless garlic powder+10 ml. of 5% enzyme extract	.. 3,293.0	0.50	13*	Good
III	5% enzyme extract alone	.. 756	0.105	Nil	..

* 1.70 of garlic powder + 5 ml. of 5% crude enzyme extract, volume made up to 50 ml. 0.05 ml. of it was utilised for A.B.A.

enzyme solution whereas the enzyme solution by itself in the concentration used did not have any antibacterial potency. The diameter of zone of inhibition was 13 mm. as compared to nil in the case of odourless powder.

The objective flavour evaluation of the tubes, prepared as discussed earlier, clearly indicated increased fresh flavour development in the case of enzyme-treated odourless garlic powder due to liberation of allicin. The starch containing the enzyme preparation did not show any flavour. The odourless powder mixed with distilled water also did not exhibit any flavour indicating thereby that presence of allinase is essential in the generation of allicin from allin present in the odourless garlic powder.

Grateful acknowledgment is made to Dr. V. Subrahmanyan, Director, for the keen interest in these investigations and to Shri V. Sreenivasamurthy for the help in determining the antibacterial activity.

Central Food Technological
Research Institute,
Mysore,
April 18, 1959.

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L. J. SINGH.
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ISOTOPE DILUTION TECHNIQUE IN THE STUDY OF INTERCONVERSION OF THE LOWER FATTY ACIDS IN IN VITRO INCUBATION OF RUMEN CONTENT OF SHEEP

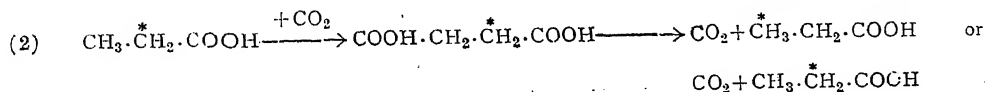
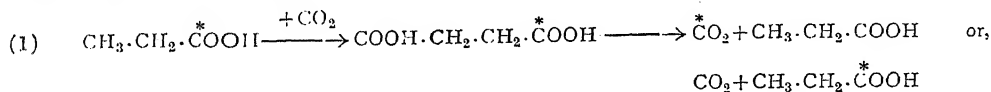
RUMEN samples from fistulated sheep were collected soon before offering the morning quota of concentrates, under CO₂ atmosphere, and incubated at 39° C. for 3 hours in an atmosphere of CO₂ with 1-C-14 labelled acetate, propionate and butyrate in turn. A few samples were collected after 20 hours of fasting. The acetic, propionic and butyric acids in the rumen content were quantitatively separated by liquid-liquid partition chromatography, using Celite 535 as the inert support, 2 molar phosphate buffer of pH 6.5 as the stationary phase and chloroform-butanol mixtures as the mobile phase. For the separation of butyric, valeric and caproic acids a buffer of pH 7.6 was used (Bueding and Yale, 1951). The specific activity of the sodium salts of the volatile fatty acids, separated by chromatography, was measured by evaporating to dryness an aliquot of the chromatographic fractions, dissolving the residue in a known small volume of water plating a convenient aliquot (containing about 5 micro-moles of the sodium salt), and counting its activity in a Geiger counter. The specific activity, when multiplied by the total amount of the salt present in each chromatographic fraction, gave the total activity in that fraction. The initial and final specific activities of acetic, propionic, butyric and valeric acids were thus determined and the total activity in each was calculated. The total activity in CO₂ was also measured in a few experiments. The CO₂ of the incubation flasks was absorbed in N/10 NaOH for 1 hour in absorption towers, and its activity was measured as BaCO₃.

These experiments clearly indicated that, excepting with active butyrate, where activity transfer into acetate was 12.9% of the initial activity added, in the sample from a non-fasting sheep, and 29.3% from a fasting animal, the inter-transfer of activity amongst the acids was less than 3% in 3 hours. An interesting feature noticed was that with active propionate much more activity was present in the valeric

compared to the butyric acid, indicating the possibility of condensation of two molecules of propionic acid to form a molecule of valeric acid—a reaction going in the reverse direction to the familiar Beta-oxidation process. This finding is in agreement with that of Popjack in a lactating goat (Popjack, 1951). With active acetate, however, both propionate and butyrate showed some activity (about 2% each). The activity in the propionate may be due to decarboxylation of succinic acid (Elsden and Sijpesteijn, 1950) which is formed in course of the oxidation of acetic acid through the citric acid cycle.

The amount of activity transferred to CO₂ presented many interesting points. When expressed as percentage of the initial activity of the fatty acid added, it was 0.5% with 1-C-14 acetate, 32.8% with 1-C-14 propionate, nil with 2-C-14 propionate, and 5.2% with 1-C-14 butyrate. The high CO₂ activity with 1-C-14 propionate is most probably due to the reversible reaction-Propionate \rightleftharpoons Succinate taking place fairly rapidly, as has been observed by Pennington with rumen epithelium (Pennington, 1952). This hypothesis is further corroborated by our observation that no activity was detected in the CO₂ when 2-C-14 propionate was used in place of 1-C-14 propionate in the incubation. The course of events with the two differently labelled propionates are represented below.

The total recovery of activity from the different acids and CO₂ combined also presented certain interesting points. With 1-C-14 acetate in the non-fasting sheep, all the initial activity was recovered in the acetate, propionate and butyrate; while in a fasting animal only 81% was recovered. Since, in a separate experiment with 1-C-14 acetate in a fasting animal, only 0.6% of the initial activity was found in the CO₂, it seems highly probable that, at least in the fasting state some acetate may be converted into ketone bodies, or into the many intermediate compounds of the citric acid cycle. With 1-C-14 propionate, in a fasting animal, whole of the initial activity was recovered in the three acids and the CO₂, indicating very little, if any, loss through ketone bodies or the



citric acid cycle. With 1-C-14 butyrate, however, as much as 35% of the initial activity was unaccounted for. This loss can readily be explained by the possible formation of ketone bodies which is known to be an important pathway in the metabolism of butyrate (Dakin, 1921; Pennington, 1952).

This work was carried out at the Rowett Research Institute, Bucksburn, Aberdeenshire, Scotland, while on deputation from the Bihar Government during 1957 and 1958. The author wishes to express his grateful thanks to the Director Dr. D. P. Cuthbertson, for kindly offering very liberal facilities for the work, to Dr. R. J. Pennington for suggesting the problem and for very valuable guidance in course of the work, and to Mr. R. Green for generous technical assistance.

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Bihar Veterinary College,
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A NOTE ON THE OCCURRENCE OF CHALCOPHANITE IN THE MANGANESE ORES OF TIRODI, BALAGHAT DISTRICT, M.P.

CHALCOPHANITE, a hydrous manganese-zinc oxide with the composition $(\text{Mn}, \text{Zn}) \text{O.2 MnO}_2 \cdot 2\text{H}_2\text{O}$, has not, to the best knowledge of the author, been reported from any locality in India in the manganese ores associated with the gondites. It is found as needles and fine-grained aggregates in association with the secondary manganese minerals Pyrolusite and Psilomelane which vein and replace a Jacobsite ore associated with highly metamorphosed rocks like Biotite-gneiss, Gondite and Sillimanite-mica-schist belonging to the Mansar stage of the Sausar Series of Dharwar age.

The properties of the mineral are as follows:

It does not take a good polish. Colour: Grey-white to very dark grey. Reflectivity: Low to moderate. Maximum reflectivity slightly higher than that of Psilomelane and minimum reflectivity much lower than that of Jacobsite. The values for green light (Maximum 29.5 and minimum 10) in air were determined by the Visual Microphotometer. Pleochroism: Ex-

tremely strong. Anisotropism: Extremely strong but without any typical colours. Extinction often undulose but when not so, four distinct extinctions per revolution are seen. Often shows red internal reflections, especially in oil. Hardness: Very low. The value of Vicker's hardness (ranging from 265 to 350) was kindly determined by Prof. Sripadrao Kilpady. The mineral does not show any cleavage, probably due to its fine-grained nature.

ETCH REACTIONS

Positive.— HNO_3 —(concentrated); HCl —(concentrated), reagent turns brown; Aqua regia—reagent turns brown. Stains some grain brownish; H_2O_2 —strong effervescence. Probably tarnishes some specimens. SnCl_2 (saturated) + HCl (concentrated)—Tarnishes distinctly.

Negative.— HNO_3 , HCl , KCN , KOH , HgCl_2 .

The extremely strong pleochroism and anisotropism, the markedly high difference between the maximum and the minimum reflectivity values, the red internal reflections, the distinct extinctions, the very low hardness, the association with secondary minerals like Pyrolusite and Psilomelane and the etch reactions are characteristic of Chalcophanite.

X-ray and chemical study, to corroborate the evidence of optical study, will be undertaken very shortly.

The author is greatly indebted to Prof. Sripadrao Kilpady, Head of the Department of Geology, Nagpur University, for his valuable guidance.

University Department of S. P. DESHPANDE.
Geology,
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SIGNIFICANCE OF APPLICATION OF NITRATE FERTILIZERS IN PADDY SOILS

EXPERIMENTS with nitrogen fertilizers were carried out in acid meadow paddy soil and alkali soil without lime content in the surface layer. The aim of these field experiments was to compare the effect of ammonium sulphate and fertilizers containing nitrate. In certain years considerable differences were found in the crop in spite of the identical treatment.

Yields obtained in 1955 were significantly lower than those of the later years. In this year, when the weather was very cloudy and cool, 340 kg. ammonium sulphate basal and 170 kg. top-dressing per hectare, favoured the appearance of the browning-disease and the average yields reached from 5.8 to 10.2 q (control: 13.6-17.0 q) per hectare. In the same year in certain areas known as susceptible to the browning disease due to H_2S , the yield was completely ruined.

In the following years (1956, 1957, 1958), however, the average yields obtained amounted to 50.7-55.6 q per hectare with the same treatment (control: 20.4-28.9 q). The cause of the striking differences is to be attributed to the favourable weather conditions of these years, chiefly to the abundant radiation. Under such conditions the vigorous synthetic processes of the rice plant provide such a quantity of oxygen that is sufficient to overcome the toxic effect of H_2S forming in the waterlogged soil, i.e., the cause to browning disease.¹⁻⁴ Fig. 1 shows the radiation and mean temperature of the months of experimental years.

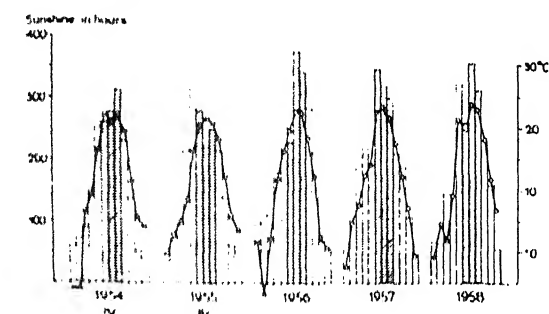


FIG. 1. Radiation and mean temperature of the months from 1954-58.

Browning diseased years.
Temperature.
Radiation.
June, July, August.

These experiments showed that the application of ammonium sulphate favours the browning disease under unfavourable weather conditions. Applying the nitrate fertilizers in top-dressing the result was remarkably different.⁸ It has been repeatedly stated also in our trials that NH_4-N is the source of N for the paddy plants;^{3,5,6} all the more as the NO_3-N disappears in the days following the flooding.⁴ It had been noted in 1955 the beneficial effect of the nitrates, after stem elongation, was mainly in heading. On the basis of this experi-

ence experiments were carried out in the following years. Sulphate-nitrate fertilizers applied together at the time of stem elongation (200-200 kg. ammonium sulphate and ammonium nitrate) following the 340 kg. $(NH_4)_2SO_4$ basal fertilizers, yielded 56.4-64.2 q (control: 27.2-30.6 q) in 1957 and 1958 under very favourable weather conditions.

Laboratory experiments were made to elucidate definitely the beneficial effect of nitrate fertilizers applied at the time of heading. Ammonium sulphate and ammonium nitrate in addition to synthetic and natural Chilean potassium and sodium nitrates were used. It has been stated that the organic substances (i.e., cellulose) decomposing in an aerobic condition in waterlogged soils renders possible the sulphate reduction and formation of H_2S . On the other hand, the nitrate fertilizers applied together with ammonium sulphate prevent the formation of H_2S and oxidise the FeS already produced.

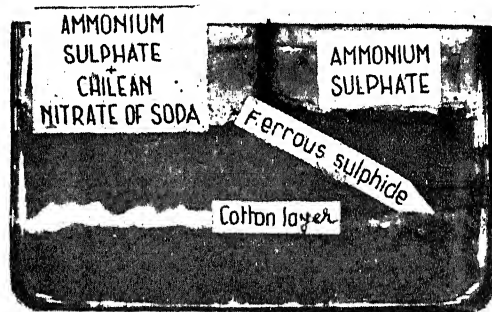


FIG. 2. The nitrates preventing the formation of H_2S . As in Aberda's opinion⁷ the rice plant in generative phase, i.e., in time of heading supplies less oxygen for the roots, the fertilizers containing nitrates, as oxidising compounds, may give considerable help to overcome the toxic effect of H_2S .

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ISOLATION OF A PERENNIAL
SORGHUM

THE present report is the result of the attempt to evolve a rust-free strain of sorghum by natural selection and segregation carried over from generation to generation from 1936 to 1954, with the least interference with the economy of nature.

The problem was undertaken in 1936 at the Experimental Dairy and Farm started by the author at Mothrawala. Medium size sorghum seeds were purchased from the local market for sowing. Selection, segregation or isolation of seedlings, which were rust-free or comparatively less affected, was carried on till they were at the maximum six weeks old. No discrimination was made while collecting or sowing the seeds. Sowing and harvesting was done annually at the usual season till 1954.

During the progress of the work the author often lost almost all the plants and seeds and had to depend on vegetative propagation or had to continue the work with a few seeds only. The feasibility of the problem was indicated by the few plants in 1937 with only the lower few leaves affected with rust. The perennial nature of the sorghum was noticed in 1945 but no importance was attached to it then. The strain became almost rust-free in 1947, but no seeds could be obtained owing to heavy infestation by aphids. No seeds could be obtained from 1950 to 1953, but in 1954 seeds appeared bold for the first time. Enquiries at Agricultural Research Institute, Delhi, Coimbatore and at other agricultural farms revealed that no perennial sorghum was evolved or cultivated in India, so further study of the perennial sorghum thus isolated interested the author.

CHARACTERISTICS

Under the climatic conditions of Dehra Dun the strain of sorghum isolated is not only of a perennial nature but is also a perpetually blooming and seed-producing variety, provided the winter minimum temperature does not fall below 10° C. and the maximum summer temperature is not above 40° C. Beyond these temperature limits very few or practically no seeds are formed. Once sown it lasts for years or as long as moisture and nutrition are available from the ground, and several crops can be obtained in a year. Heavy rains, hailstorms, or droughts have practically no effect on it. It has great adaptability to its environment; on non-irrigated lands under unfavourable conditions it remains quiescent, but revives on return of favourable conditions. Its yield of

grain is incredibly large. Field trials from 1956 to 1958, conducted on irrigated plots of 1/40 of an acre, on grounds attached to the District Jail, have shown that it is possible to obtain 16,000 to 20,000 lb. of grain per acre. Its maximum yield and number of crops may be expected, at places where the summer maximum temperature does not go above 40° C. and the winter minimum below 10° C. The details of the work will be published in due course.

Most of the work reported here was done on non-irrigated and irrigated lands in Dehra Dun at the following villages. Mothrawala, Chalgaoon, Asthal, Dhoran, Danda-Lakhond, Shemshargarh, Karavan Gaon, Kaulagarh and Ballupur, with the kind help and co-operation of late Shri Mahant Laxman Das and Col. S. Blake and Mr. E. Young, Principal, Normal School, among others, in their respective villages and farms. Author's thanks are due to them and to Shri B. D. Arora and Shri M. M. Srivastava the then Jailors by whose courtesy the field trials could be conducted.

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 April 28, 1959.

SEX REVERSAL IN HEMP BY
APPLICATION OF GIBBERELLIN

Cannabis sativa L. under normal conditions of growth behaves as a dioecious plant. However, the sex in this plant can be reversed by alteration of cultural conditions as well as by application of auxins. Tibeau¹ obtained only female plants in high nitrogen and only male plants in low nitrogen in sand culture. According to McPhee² both time of flowering and sex in hemp are determined by light. Breslavetz³ showed that extreme shortness of day causes sex reversal in hemp. Heslop-Harrison⁴ observed that application of α -naphthalene acetic acid induced the formation of female flowers in genetically male plants. In the present investigation application of gibberellin has been shown to induce formation of male and hermaphrodite flowers in the genetically female plants.

Seedlings of *C. sativa* were transplanted into 10 inch pots at the 4-leaf stage. They were treated at weekly intervals with a 100 p.p.m. aqueous solution of gibberellin (Pfizer) by foliar spray. Ten plants were thus treated and an equal number of plants was used as control. The pots were kept under partial shade throughout the duration of this experiment. Flowering commenced at the end of four weeks after

the first application of gibberellin in case of both treated and control. Observations on flowering behaviour were continued for six subsequent weeks.

Out of the ten treated plants, five plants bore only male flowers throughout. These gibberellin-treated male plants had very conspicuous long panicles as compared to the untreated male plants where the flowers are borne in short axillary racemes. The number of flowers in the treated male plants was also much more than that in untreated plants.

Out of the remaining five treated plants only one was purely female and did not show any sex reversal, while the remaining four were genetically female, but each started as a male and later reverted to female. The number and extent of male flowers produced on such genetically female plants was variable. In general, first male flowers, two to five in number, appeared about the leaf axil of the sixth node. The male flowers continued for the next one to three nodes. This was followed by two to three nodes bearing only two female flowers in each leaf axil, one each on either side of the axillary axis. On subsequent nodes long axillary spikes were borne. On these lateral spikes again the male flowers preceded the female flowers (Fig. 1). In the

characteristic of female flowers, containing a cup-shaped perianth, an ovary with a distinct style and partly protruding anthers.

In the case of untreated plants, six were male and remaining four were female. Out of the four female plants only one showed slight tendency towards maleness. In this plant a single male flower was produced at the sixth node and all subsequent nodes produced only female flowers.

In order to prove that the plants, in which male flowers preceded the female flowers, were actually genetically female, gibberellin was applied at flowering stage to a normal plant which was producing only female flowers. The spikes on this plant, formed subsequent to the gibberellin application, bore male flowers followed by female flowers. This showed further, that gibberellin caused reversal of female to male during the period of differentiation of flower primordia.

From the observations described in the foregoing, it is clear that gibberellin brings about maleness in genetically female plants. In spite of the voluminous work on gibberellin as is recently reviewed by Stowe and Yamaki⁵ and Wittwer and Bukovac,⁶ no effect of gibberellin on the sex of dioecious plants is described. This is the first report showing that gibberellin can cause sex reversal in a dioecious plant. It is of significance⁶ that gibberellin consistently increases the number of staminate flowers preceding the first pistillate flowers in cucumber. In the light of this it is likely that the gibberellin, in case of female hemp plants, greatly enhances the tendency of the formation of male flowers. Such tendency pre-exists to a limited extent in the genetic material used in the study.

The author is indebted to Prof. P. N. Mehra for granting facilities for this work and for helpful suggestions. Thanks are also due to Dr. Dave Carew of the University of Iowa for furnishing the sample of gibberellin.

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Amritsar, May 20, 1959.



FIG. 1. A spike from the treated female plant showing male, hermaphrodite and female flowers in succession. axils of first two to three bracts on these spikes only male flowers were formed followed by one or two hermaphrodite flowers and in the terminal portion of the spike only female flowers were formed. The male flowers thus formed on genetically female plants produced normal pollen grains. The hermaphrodite (Fig. 1A) flowers had an ensheathing bract,

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OIL FROM THE SEEDS OF ACACIA DECURRENS WILLD.

A NUMBER of Acacias, both indigenous and exotic, have been grown in India principally for their tanbarks. *Acacia decurrens* Willd. is one such exotic largely grown on the Nilgiris and also latterly in Uttar Pradesh.

This note records the properties of the fixed oil from the seeds of *Acacia decurrens* Willd. The oil was prepared in a yield of 9.41% by solvent extraction of the powdered mature seed with ether in a Soxhlet.

The oil deposited a white flocculent sediment. The clear oil had the following properties:

Appearance	.. Clear oil, showing some white flocculent sediment at the bottom of the container.
Colour	.. Pale-brown.
Odour	.. Peculiar, resembling that of Mustard oil group.
Acid value	.. 10.5.
Refractive index at 40° C.	.. 1.4707.
Saponification value	.. 190.8.
Iodine value	.. 137.1.
Percentage of oil obtained	.. 9.41.

It will be seen that the Iodine value compares favourably with that of other well-known drying oils. This suggests a profitable outlet from the seeds of *Acacia decurrens* Willd. estimated at some 1,000 lb. per year per acre in the Nilgiri area.

Work on the fatty acids of the oil is in progress. The author thanks Sri. K. S. Srinivasan, Curator, for help and encouragement.

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Indian Museum, Calcutta,
July 22, 1959.

EFFECT OF HORMONES ON THE SEX-RATIO IN MANGO

CHOUDHARI (1957) reviewed literature on "The possible significance of photo-period and hormones in sex-expression and sex-reversal in plants" and suggested that sex-reversal in plants may be due to hormone change. According to Over Beek (1952) treatment of plants with Naphthalenacetic acid speeds up appearance of female flowers in cucurbits. Nitsch *et al.* (1952) also observed that low temperature causes a very rapid transition of the plants to female phase. This again may be due to the

effect of low temperature on the concentration of hormones. With these references in hand a preliminary trial was arranged on February-March flush of Kalapady variety of mango, introduced into Bihar from South India. This variety when newly introduced in Bihar in 1935 was flowering three times in a year up to 1947, once in November-December again in February-March and a third time in April-May. Since 1947, however, there are only two flushes, once in February-March and again in April-May. It has been noted that the flowers formed in February-March and again in April-May differ in sex-expression, the first flush having nearly 99% male flowers.

Hormone treatments consisted of aqueous sprays of B-Naphthalenacetic acid in 0, 50 and 100 p.p.m. concentrations on the whole plants just before the onset of flower buds. Teepol was used as an adhesive agent. The treatments were replicated 6 times. Five uniform panicles were selected from each tree for flower count. Each panicle was enclosed in a muslin bag which could be opened when required. The dried flowers that fall into the bags were counted daily. The results are presented in Table I.

TABLE I

Treatments	Average No. of flowers per panicle		No. of female flowers to total	Ratio of male to female
	Male	Female		
1 Control	573	29	4.8	20 : 1
2 B-Naphthalenacetic acid 50 p.p.m.	548	40	6.8	14 : 1
3 B-Naphthalenacetic acid 100 p.p.m.	480	53	9.9	9 : 1

C.D. at 5%

±2.44

It is evident from Table I that spray of hormone at both concentrations has significantly increased the ratio of female flowers.

Agric. Research Inst.,
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May 21, 1959.

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STUDIES ON HETEROTHALLISM—V
Dædalea flavida Lev.

The problem of sex in Hymenomycetes is considerably complicated by the occurrence of 'physiological heterothallism of multiple allelomorph type' (Whitehouse, 1949). The modern tendency of the workers in this field is to regard heterothallism as a device which increases outbreeding by reducing the chances of fertile mating between haploids from one diploid individual (Mather, 1942). The study of sex and sex groups in the members of this group of fungi is, therefore, of great biological importance and researches on the sexuality of Hymenomycetes commonly occurring in India have steadily been extended by several workers during the last two decades. The present investigation has been carried out on *Dædalea flavida* Lev., a common polypore of tropical and sub-tropical India, and thus forms a part of the series previously mentioned by the writers (Banerjee and Samadpour, 1957).

The fact that, in *D. flavida* the mycelium of polyporous origin produces abundant clamp-connexions but there are not met with in the mycelium developed from a single spore induced the writers to assume the heterothallic nature of the species. In order to solve the enigma mating experiments with mycelia of monosporous origin were therefore, undertaken.

Twenty monosporous cultures were made following the usual dilution method (Smith, 1946) from spores obtained from a single sporophore growing on logs of *Shorea robusta* Gaertn. f. Of the twenty cultures lacking clamp-connexions, fifteen were paired in all possible combinations on 2.5% malt-agar slants (pH 6) in tubes and allowed to grow for one month under ordinary conditions of temperature (28–32 °C.) and diffused light of the laboratory. After one month's growth the line of contact between two interacting mycelia was critically examined for the presence of clamp-connexions and the types of reactions exhibited were recorded. The results of these examinations are given in Table I. The presence or absence of clamp-connexions has been considered as the criterion of the compatibility or incompatibility of the interacting hyphae of a testing pair. Compatible reaction indicated by the presence of clamp-connexions has been designated by the (+) sign and all other incompatible reactions showing absence of clamp-connexions have been designated by the (-) sign.

From Table I, it is evident that *D. flavida* is 'heterothallic' and sexually 'bipolar'. The

interacting mycelia fall under two mating types and any member of one type is compatible with any member of the other type. Table I also indicates that the two types are intercompatible

TABLE I

Pairing of 15 monosporous mycelia derived from a single sporophore of *Dædalea flavida* Lev.

		A						a								
		1	6	8	9	10	11	12	2	3	4	5	7	13	14	15
A	1								+	+	+	+	+	+	+	+
	6								+	+	+	+	+	+	+	+
	8								+	+	+	+	+	+	+	+
	9								+	+	+	+	+	+	+	+
	10								+	+	+	+	+	+	+	+
	11								+	+	+	+	+	+	+	+
	12								+	+	+	+	+	+	+	+
a	2	+	+	+	+	+	+	+								
	3	+	+	+	+	+	+	+								
	4	+	+	+	+	+	+	+								
	5	+	+	+	+	+	+	+								
	7	+	+	+	+	+	+	+								
	13	+	+	+	+	+	+	+								
	14	+	+	+	+	+	+	+								
	15	+	+	+	+	+	+	+								

but not intracompatible. As regards the genetic explanation of this type of sex in Hymenomycetes it is a well accepted fact that a single allelomorphic pair of factors (Aa) are present in the synkaryon of the basidium. The two factors (A) and (a) are present in the same locus on different chromosomes. During meiosis the two factors disjoin and segregate equally so that two of the tetracyte nuclei receive one kind of factor (A) and the other two nuclei receive the opposite factor (a). Thus, in each spore only one factor (A or a) is present. Mycelia developed from these spores have the same genetic constitution and will contain either the factor (A) or (a) and are eventually of two types which are sexually different.

Incidentally, few macroscopically visible reactions have been recorded which are as follows:—

Compatible.—The two monosporous mycelia intermingle to form a perfect homogeneous mat which superficially looks like the typical polyporous culture. Abundant clamp-connexions indicate that copulation has taken place.

Neutral.—The two monosporous mycelia intermingle to form a homogeneous mat but the resulting mycelium with clamp-connexions is not produced. In some cases a narrow line

of condensed hyphæ is visible in the region of apparent intermingling of the testing pair. In other cases the two reacting mycelia do not intermingle and leave a narrow somewhat wavy line separating the two mycelia at the point of contact.

Irrespective of the above visually recognizable types of reaction, the presence or absence of the clamp-connexions has been considered as the sole basis in determining the polarity and sex-groups present in *D. flavida*. No importance, has been laid on these reactions particularly on some neutral types which apparently seems to be 'antagonistic'. But this cannot be homologous with what Kaufert (1936) called 'antagonism', because the fungus (*Pleurotus corticatus* Fr.) he studied was a 'tetrapolar' species and the fungus under consideration is a 'bipolar' one according to the present compatibility test.

Dept. of Botany, SACHINDRANATH BANERJEE.
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A NOTE ON THE INHERITANCE OF HEIGHT IN SORGHUM

SORGHUM varieties range in height from 2 to 15 feet. The inheritance of this character was studied in India and U.S.A. to a great extent. In this paper, the experiences recorded on the inheritance of height in a cross between Bonganhilo (*Sorghum caudatum*, Stapf AS. 4003) and *Pyrus Jonna* (*S. durra*, Stapf, G.2 *Jonna*) are reported.

Tallness was reported to be dominant by Karper (1932). Sieglinger (1932) also reported a single factor segregation of three tall to one dwarf in broom corn. Ayyangar *et al.* (1937) reported "short-early" as dominant over "tall-late". In this case segregation for internodes was reported and not for a gene that influences elongation of internodes. Quinby and Karper (1954) reported tallness as partially dominant.

At the Agricultural Research Station, Lam, crosses were made between G. 2 *Jonna* and AS. 4003. The behaviour of the progenies with reference to height is reported below.

TABLE I

Variety	Group	No. of plants	Average height in cm.	Range of height in cm.	S.E.
G.2 <i>Jonna</i> ..	Tall	25	161	150-168	0.91
AS. 4003 ..	Short	25	102	96-114	1.14
F.1 hybrid ..	Medium	18	140	123-160	2.7

It is seen from the above data that the F. 1 hybrids were of medium height. In the F. 2 generation, 160 plants of medium height and 58 short plants were obtained conforming to the 3 : 1 ratio.

	No. of medium height plants	Average height	No. of short plants	Average height
F.2 generation (observed)	160	130	58	101
Calculated on 3 : 1 ratio ..	163.5	..	54.5	..

$$\chi^2 = 0.29 ; P = 0.5.$$

The above data show that the character tallness is partially dominant.

As already pointed out, Ayyangar (1937) reported segregation for two types of internodal disposition. In the "short-early" plants there were on an average 10.6 internodes with *Unimodal* disposition and in the "tall-late" plants there were 16.7 internodes with *bi-modal* disposition. The "short-early" plants were reported to be dominant over "tall-late" plants. In, produces "short-early" plants with *Unimodal* disposition of internodes, in, gives rise to plants that are "tall-late" with a greater number of internodes and their *bi-modal* distribution.

Taking this into consideration the internodal lengths and disposition were examined in both G.2 *Jonna* and AS. 4003 and the data are given in Table II.

Ayyangar *et al.* (1938) described three types of internodes in *Jonna*, viz., *Uniform increase*, *Unimodal* and *bi-modal*. According to this, the internodal disposition is of *Uniform increase* type in G.2 *Jonna* and *Unimodal* in AS. 4003. The F.1 hybrids possessed plants with *Uniform increase* inter-nodal disposition, revealing the dominant nature of this character over *Unimodal* type. In the F.2 generation, plants with longer and *Uniform increase* internodes produced tall plants while plants with short and *Unimodal*

TABLE II

Variety	Length of internodes in cm.											Mean No. of internodes
	1	2	3	4	5	6	7	8	9	10	11	
G.2 <i>Jonna</i> ..	1.4	5.5	12.3	16.3	18.1	19.7	21.6	21.8	23.0	..	..	8.0
AS. 403 ..	1.2	3.4	5.9	8.5	9.9	11.2	11.1	10.3	10.8	10.6	9.5	10.3
F.1 hybrid ..	1.7	7.0	12.1	17.7	20.3	21.3	21.4	21.5	21.8	..	..	8.5

internodes produced short plants. These preliminary studies on height and internodes reveal that (i) tallness is partially dominant, (ii) *Unimodal* increase type of internodal disposition is dominant over *Unimodal* type, and (iii) the height in *Jonna* depends upon the length and number of internodes.

My thanks are due to Sri. S. Ramachandrarao, Millet Specialist, Andhra Pradesh, for the valuable suggestions offered in preparing this note. Agricultural Research Station, C. SREERAMULU, Lam A.R.S., P.O., Guntur-2, May 19, 1959.

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LEAF-SPOT OF ROSE CAUSED BY *CURVULARIA LUNATA* (WAKKER) BOEDIJN

A LEAF-SPOT disease of garden rose though not of very serious nature was commonly found at Sabour in the months of July to November in the last three years. Careful examination of the infected leaflets revealed isolated, irregular, light brown spots on the leaf surface. The spots increased in size, affected leaflets turned yellow, then started drying up and in some cases were finally shed off.

Microscopic examination of the scrapings of the spots revealed the presence of brown and mostly 4-celled conidia and cultural studies proved this to be those of *Curvularia*. Platings of the surface sterilized (in mercuric chloride, 1:1000) infected leaves of rose on potato-dextrose agar medium yielded the fungus with the colour of the mycelial colony changing from white to greenish dark. Copious conidial formation took place in 5-7 days. Intercalary thick-walled Chlamydospores were found in many cultures.

Pathogenicity tests conducted with a single spore culture of the fungus gave positive results.

So far, in India, *Curvularia* has not been reported on rose.¹⁻³

The morphological and pathological characters of the fungus are described below:—

Mycelium septate, hyaline to greenish brown; Conidiophores rigid, straight or bent, 2-9-septa, olive brown, 123-205 × 4.1-6.15 μ broad. Conidia clavate, pear-shaped or elongate, straight or bent, thick-walled, 3-septate, olive-brown, third cell from base broader and darker and constriction at septa not prominent. Conidia from cultures were 24.3 × 10.7 (18-28 × 9-13) μ. Pathogenicity tests were attempted by the standard technique on rose, young and older leaves of bajra and on the male inflorescence of maize. Inoculations on rose only were successful.

The morphological and cultural characters indicate that the fungus isolated from rose is *Curvularia lunata*.⁴⁻⁶

The authors are grateful to Dr. B. L. Chona, Systematic Mycologist, I.A.R.I., New Delhi, for his help in identification of the fungus and to Dr. R. H. Richharia and Prof. N. B. Syamal for providing all facilities.

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PARTHENOCARPY IN GUAVA INDUCED BY 'POLLEN HORMONE'

Most of the naturally formed seedless or parthenocarpic fruits are produced either without pollination or pollination without fertilization. In the case of pollination without fertilization, it has been reported in some orchids, cucumber, solanaceous plants, etc., that

the development of parthenocarpic fruits is due to some chemical present in the pollen grains, otherwise known as 'pollen hormone'.¹⁻⁴ In our studies on the floral biology and fruit-set of three varieties of guava (*Psidium guajava* L.) certain interesting observations on the development of the ovary without fertilization were made and the results are reported here.

Three-year old guava plants of the varieties, 'Allahabad Round', 'Chittidar' and 'Lucknow' in the Annamalai University Experimental Orchard were selected for the studies. When the flowers were emasculated in the usual manner and self-pollinated artificially it was found that in all the three cases there was fruit-set. In the absence of pollination, i.e., when the flowers were bagged soon after emasculation, there was no fruit development. The fruits developing from the self-pollinated ovaries of 'Chittidar' and 'Lucknow' were profusely seeded, whereas the ones in 'Allahabad Round' were completely seedless.

With a view to examine the details of the fertilization process, pollen grains from the flowers of the three varieties were collected immediately after, or just prior to, their opening and they were tested for viability. The grains were first placed in various concentrations of aqueous glucose ranging from 2 to 10%. It was found that the maximum percentage of germination of the pollen grains of 'Lucknow' and 'Chittidar' was obtained in 6% glucose solution. But the pollen grains of 'Allahabad Round' failed to germinate in any of the concentrations tested, except for minute protrusions of the exine through the germ pore, which failed to develop into normal germ tube even after 48 hours. The length of protrusions reached a maximum of 22.5μ in 'Allahabad Round' as against over 200μ of germ tubes in the other two varieties. Subsequently, the pollen from the latter variety was tested for germination in 15, 20 and 25% cane-sugar solutions and there was no germination in any case.

The germination under natural conditions of the pollen grains of three varieties was also examined by artificially applying the grains to the stigma of the emasculated flowers at different intervals, before and after their opening. It was found that in the case of 'Chittidar' and 'Lucknow', when applied two hours after the opening of flowers, there was normal development of pollen tube indicating thereby that the stigma is receptive only around that period. In the case of 'Allahabad Round' no germination or protrusion of the pollen could be observed in any of the treatments.

In order to examine whether there was any 'pollen hormone' effect in the case of 'Allahabad Round', the grains were collected from the flowers immediately after opening and crushed thoroughly in a pestle and mortar with the addition of small quantities of distilled water. The resulting paste was examined under the microscope and found that none of the pollen grains were intact. The paste was then diluted in distilled water, filtered through muslin cloth and the filtrate was applied to the stigma of emasculated flowers and were bagged in the usual manner. Fifteen flowers were treated in similar way and observations made on the development of fruits. It was observed that in all the 15 cases the ovary had developed into seedless fruits and when they were cut open it was found that there was a central round cavity coated with brownish powdery aborted ovules (Fig. 1).

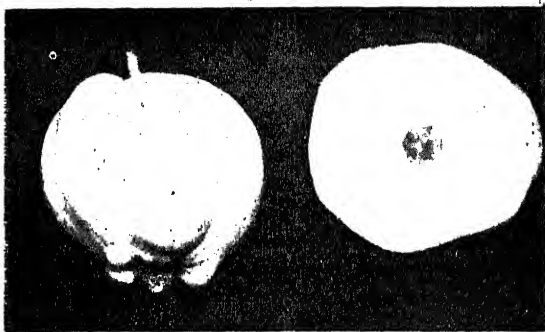


FIG. 1. 'Allahabad Round' fruit with transverse section showing the characters of parthenocarpy.

The parthenocarpic fruits are characterised by 6 to 8 prominent ridges on the surface and swellings in the calyx-end, corresponding to the ridges. The fruits take nearly a month longer to mature as against $3\frac{1}{2}$ to 4 months in the seeded fruits. The fruit pulp is also more granular and tasty than the seeded ones of the same variety.

In order to study the compatibility of foreign pollen grains with 'Allahabad Round', the grains from 'Chittidar' and 'Lucknow' were used for pollinating the emasculated 'Allahabad Round' flowers and vice versa. It was found that the pollen from 'Chittidar' and 'Lucknow' fertilized the ovary of 'Allahabad Round' giving rise to fruits with 10 to 12 seeds per fruit; the pollen grains of 'Allahabad Round' failed to fertilize the ovaries of the other two varieties and also

there was no parthenocarpic development of the fruits.

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EFFECT OF CERTAIN ORGANIC INSECTICIDES ON THE YIELD OF WHEAT CROP

BESIDES the role of controlling the insect pests the insecticides also have other effects on the plants, *viz.*, they may prove beneficial and give better yields or otherwise. Very recently

The data of the yield of wheat crop are tabulated in Table I.

In the trials (Table I) 0.25% DDT and 0.04% Folidol have resulted in increased yields as compared to the 'control' (being 1 lb. 8 oz. and 14 oz. over the control). The poorest performances were, however, given by 0.05% Endrin and 0.15% DDT followed by 0.03% Folidol and 0.075% Endrin, and 0.20% DDT. 0.02% Folidol and 0.10% Endrin. The above results are based on the observations of one year.

Thanks are due to Shri R. B. Gupta and Shri S. P. Acharya for carrying out the treatments.

Division of Entomology, J. G. PAWAR.
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May 9, 1959.

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TABLE I

Treatment	Replication I		Replication II		Replication III		Total of three replications		Variation from control	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1 0.15% DDT	7	6	6	4	8	0	21	10	-3	6
2 0.20% do.	7	12	8	12	7	12	24	4	-0	12
3 0.25% do.	8	4	10	0	8	4	26	8	+1	8
4 0.02% Folidol	7	2	8	0	9	4	24	6	-0	10
5 0.03% do.	7	12	8	3	6	4	22	8	-2	8
6 0.04% do.	9	2	7	14	8	14	25	14	+0	14
7 0.05% Endrin	9	4	4	8	6	12	20	8	-4	8
8 0.075% do.	8	0	7	4	8	6	23	10	-1	6
9 0.10% do.	7	12	8	4	8	8	24	8	-0	8
10 'Control'	8	14	8	8	8	10	25	0	..	..

Seshagiri Rao (1959) has conducted some trials on potato, groundnut, cabbage and garden beans concluding his results on the yields. The knowledge of the effect of insecticides on the yield of crops is of great value in facilitating their economic use.

Field trials were undertaken to assess the effect of different doses of DDT, Folidol and Endrin on the yield of wheat crop (variety C. 281). The crop was sown on 30-10-1958 in 30 plots of 20' x 20' size and harvested on 3-4-1959. The insecticides were sprayed twice, in three replications, at an interval of two months, first in the second week of December 1958, and next in the second week of February 1959. So far as the insect infestation is concerned, only a negligible incidence of the stem borer (*Sesamia inferens* Wlk.) was recorded.

CHAETOTAXY OF THE SOLDIER, WORKER AND ALATE OF THE TERMITE *ODONTOTERMES OBESUS* (RAMBUR)

THE study of chaetotaxy has been found to be of considerable use in taxonomic differentiation between species of higher groups in insects, particularly the Diptera adults, Lepidoptera larvæ, etc. No such study seems to have been made so far for the Isoptera. As a first step, the chaetotaxy in the common mound-building termite, *Odontotermes obesus* (Rambur) (Isoptera, family Termitidae) was studied.

About 25 specimens of each caste, *viz.*, the soldier, worker and alate, were studied and the percentage of occurrence of bilaterally symmetrical bristles calculated. The arrangement of

bristles resembles each other closely in workers and alates in the head region, and in soldiers and workers in the thoracic and abdominal regions. A nomenclature in Arabic numerals has been used for the labral bristles, but in

most other cases the bristles have been named according to their location on the body-part. The characteristic bristles observed in more than 80% of the individuals of the three castes are summarised in Table I.

TABLE I
The more important setæ and bristles in Odontotermes obesus
N.B.—All the bristles are paired, except those mentioned otherwise

Body-regions and appendages		Nomenclature of the bristles	Frequency percentage of bilateral symmetry			
			Soldier	Worker	Alate	
		I—Head capsule (Dorsal)				
Clypeus	..	.. Clypeal	100	96	..
Frons	..	.. Frontal	100	92	..
Epicranial region	..	.. { Epicranial 1	92	..	..
			{ Epicranial 3	88
			{ Epicranial 4	98
Genæ	..	.. { Medio-genal	96	..	..
			{ Proximo-genal	88
		II—Head-appendages				
Labrum	..	.. { Apical	100	100	96
			{ Apical lateral	..	100	96
			{ 1	100	100	88
			{ 2	97.5	100	84
			{ 3	95	100	96
			{ 4	95	92	96
		.. { 5	..	..	96
Galea	..	.. Disto-galeal	92	..	..
Glossa	..	.. Medio-glossal	..	88	..
Prementum	..	.. Premental 1	..	100	..
Postmentum	..	.. { Postmental 1	92	92	100
			{ Postmental 2	..	92	80
			{ Postmental 3	..	84	..
			{ Medio-postmental	96	100	..
		III—Thorax				
Prothorax	..	.. { Pronoto-anterior	100	100	..
			{ Pronoto-lateral	96	88	..
			{ Pronoto-posterior	100	92	..
Mesothorax	..	.. { Mesonoto-lateral	96	84	..
			{ Mesonoto-posterior	96
Metathorax	..	.. { Metanoto-lateral	100	88	..
			{ Metanoto posterior	96
		IV—Legs				
Fore-leg	..	.. Dorsal tibial spur (single)	100	100	100
Fore-leg	..	.. { Ventral tibial spurs	100	100	100
Middle-leg	..					
Hind leg	..					
		V—Abdomen				
Sternite 1	..	.. Sterno-posteromedial	..	100	..
Sternite 2	..	.. Ditto	100	100	..
Sternite 3	..	.. Ditto	100	100	..
Sternite 4	..	.. Ditto	100	100	..
Sternite 5	..	.. { Ditto	100	100	..
Sternite 6	..	.. { Sterno-posterosublateral	..	80	..
			{ Sterno-posteromedial	100	100	..
			{ Sterno-posterosublateral	80	95	..
Sternite 7	..	.. { Sterno-posteromedial	100	100	..
			{ Sterno-posterosublateral	95	100	..
Sternite 8	..	.. { Sterno-posteromedial	100	100	..
			{ Sterno-posterosublateral	80	90	..
			{ Sterno-posterosublateral 1	..	100	..
Sternite 9	..	.. Sterno-posterosublateral	..	90	..
Cerci	..	.. Cercal (3 bristles)	84	..	..
Subanal styles	..	.. { Stylar 1	100	100	..
			{ Stylar 2	96	96	..

For the external morphology of this species vide Kushwaha.^{1,2}

My sincere thanks are due to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for his guidance and supervision during the progress of the work and for laboratory facilities at the Forest Research Institute, Dehra Dun, and the Zoological Survey of India, Calcutta.

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FIELD EVALUATION OF SOME
ORGANIC PHOSPHATES FOR THE
CONTROL OF THE ONION THIRPS,
THRIPS TABACI LIND.
THYSANOPTERA : THRIPITIDAE

THE onion thrips, *Thrips tabaci* (Lind.) maintains its continuous breeding in the field throughout the year on Brinjal, Onion, Garlic, Bhindi, Cotton, Bottlegourd, Hollyhocks and Sunflower and causes considerable damage to the Onion and Garlic crops each year. With a view to develop a suitable chemical control of the pest, the screening tests with four organic phosphates (Folidol, Diazinon, Malathion and Metasystox) at four levels of concentration (0.01%, 0.025%, 0.03% and 0.04%) were carried out in the year 1957. In the light of the results of the screening tests, a pilot field trial with the same insecticides at one level of concentration (0.025%) was conducted in the experimental area during the year 1958. The trial included five treatments and each one was replicated four times. The size of the micro-plots was 3' × 3' and the spacing between plant

to plant and row to row was kept as 6". The initial infestation of the thrips under each replicate was estimated before starting the treatments. The population was estimated on the basis of the sample size of five leaves harvested at random and counting the number of thrips present on the leaf-samples. At the time of each observation, four leaf-samples were collected from each replicate. The performances of different insecticides after 1 day, 6 days, 12 days, 18 days and 24 days were recorded.

The data collected on the performances of different treatments are summarised in Table I. The data clearly indicate the superiority of Folidol over other treatments. The Folidol (0.025%) gave the immediate knockdown of the thrips one day after spray and its residual toxicity persisted for 12 days after the treatment.

Folidol not only gave the best performance in keeping down the thrips infestation but also improved the growth condition of the plants. No such reaction was observed in case of Metasystox. No record on the thrips population was maintained after 24 days since there was a considerable decline in the residual toxicities of the insecticides. According to Israel and Vedamurthy (1954) and Padmanabhan and Israel (1956) Folidol (0.04%) gave excellent control of the paddy stem borer.

The emulsifier incorporated in Folidol seems to maintain the toxicity of the compound when used at low concentration. The improved growth condition of plants, as observed under Folidol treatment, indicates that the organic phosphate (Folidol) used in the experiment might have been converted into available phosphates and they were in turn utilized by the plants for good growth condition. Such reactions in plants are clearly demonstrated by Fukuto and his associates (1955) and Lall *et al.* (1958) in relation to Systox.

The authors wish to express their gratitude to Dr. R. H. Richharia, Principal, for providing

TABLE I
Comparative efficacy of organic phosphates against the Onion thrips

Insecticides		Percentage dosage	Av. initial infestation per leaf	Percentage population reduction after days					Average total reduction
				1	6	12	18	24	
Folidol	..	0.025	5.785	94.04	87.25	85.99	75.52	38.85	76.33
Diazinon	..	0.025	6.435	43.35	49.08	76.55	66.30	40.41	55.14
Malathion	..	0.025	7.620	35.51	25.09	62.65	45.58	25.25	38.61
Metasystox	..	0.025	7.835	28.01	18.53	68.47	52.92	21.79	37.94
Control	..	..	8.54	9.56	9.90	16.25	11.74	11.68	..

necessary facilities in the Post-graduate Laboratory for carrying out the investigations.

Divn. of Entomology, B. S. LALL.
Bihar Agric. College, Sabour, S. K. VERMA.
May 4, 1959.

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TRANSMISSION OF CITRUS DECLINE VIRUS BY *TOXOPTERA CITRICIDUS* KIRK. IN INDIA

THE tristeza quick decline virus disease of citrus is now recognised to be of major economic importance in principal citrus-growing regions of the world. The virus nature of this disease was experimentally demonstrated in 1946 by Meneghini,¹ who successfully transmitted tristeza in Argentina through a species of black aphid—*Aphis citricidus* (Kirk.) (Synonym of *Aphis tavaresi* De Guerco and *A. citricola* Van der Goot.). In the same year Fawcett and Wallace,² later Wallace and Fawcett,³ reported transmission of quick decline in California through budding and grafting. Transmission of tristeza through *Aphis citricidus* was further confirmed by Bennett & Costa⁴ and McClean.⁵ Dickson *et al.*⁶ demonstrated the transmission of quick decline virus in Florida through *Aphis gossypii* Glover. Norman and Grants^{7,8} showed that the virus was transmitted also by *Aphis spiracecola* Paich and *Aphis gossypii* Glover, respectively.

Knorr⁹ showed that in addition to the Key lime plants which had been employed as a differential host of tristeza virus in many places, *Aeglopsis chevalieri* Swing, could also be used as a useful indicator host. Vasudeva and Capoor¹⁰ first demonstrated the presence of the virus in this country through budding and grafting.

Survey of the citrus aphids at Poona, in 1958, revealed the presence of *Toxoptera citricidus*, Kirk., colonising from November to March on all species of citrus. In the first instance, aphids breeding on diseased plants of Mosambi (*Citrus sinensis* var. Mosambi), Grape fruit (*Citrus paradisi* Macf.), Kagzi lime (*Citrus aurantifolia* Swing.) and citron (*Citrus medica* var. acid), were collected and liberated directly on Key lime seedlings raised from seed. In another set of experiments aphids were bred on healthy Key lime plants in an insect proof

glass-house and fed for 24 hours on young twigs from diseased Kagzi lime, grape fruit, and citron plants and then liberated on Key lime seedling for 12 hours. Characteristic vein-clearing symptoms indicating the presence of tristeza developed in Key lime after 40 to 100 days following inoculation in both the experiments. The symptoms faded away as the plants grew older.

In addition, two *Aeglopsis* seedlings were inoculated by first feeding the aphids on diseased Mosambi plants (Mosambi on sour orange root stock from experiments reported by Vasudeva and Capoor¹⁰) for 24 hours and then liberating them on test seedlings for 12 hours. Both the plants developed typical vein-clearing symptoms (Fig. 1) similar to those

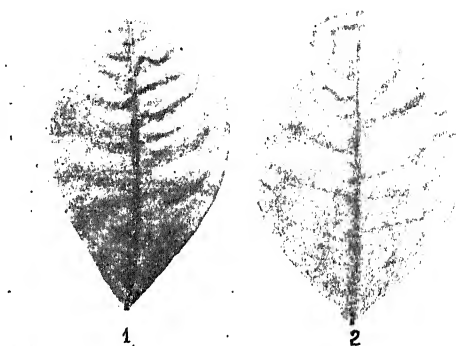


FIG. 1. *Aeglopsis chevalieri* leaves. (1) Healthy; (2) From Mosambi. This indicated that the virus present on Mosambi was similar to the strain of virus present in Argentina.

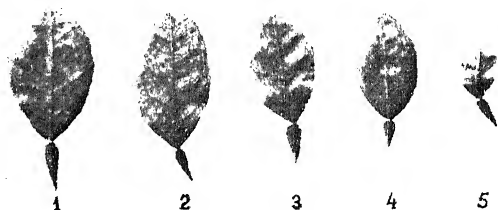


FIG. 2. Kagzi lime leaves. (1) Healthy; (2) From citron; (3) From Kagzi lime; (4) From Mosambi; (5) From late Valencia orange.

Further, young Kagzi lime plants were similarly inoculated with aphids fed on diseased

citron, Kagzi lime, Mosambi and late Velentia orange plants. The test seedlings showed typical vein-clearing in 40 to 65 days (Fig. 2) similar to the symptoms of disease observed in Kagzi lime seedlings following inoculation through budding and grafting.¹¹ Kagzi lime has not been reported previously as an indicator host for this virus.

The experiments reported above clearly show that the tristeza or quick decline virus in India is disseminated in nature through the agency of the aphid *Toxoptera citricidus* Kirk.

Division of Mycology and R. S. VASUDEVA.
Plant Pathology, P. M. VARMA.
Indian Agri. Research Inst., D. G. RAO.
New Delhi, June 16, 1959.

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**MOGHANIA MACROPHYLLA (WILLD).
O. KTZE. (SYN. FLEMINGIA CONGESTA
ROXB. VAR. SEMIALATA BAK.) AS A
NEW LAC HOST FOR GROWING THE
KUSMI STRAIN OF THE LAC INSECT**

Moghania macrophylla (Fam.: Leguminosæ; subfam.: Papilionatæ) is a tall, erect shrub growing to a height of 8'-10' with sulcate silky branches. It is widely distributed in the Himalayan and Sub-Himalayan forests from Chamba to Bhutan, Khasi and Naga hills in Assam, the hills of Parasnath and Visakhapatnam and along the Western Ghats in South India, up to a height of 5,000 ft. It is known to be one of the important minor lac hosts in Assam, chiefly in Mikir hills, for growing the *Rangeeni* strain of the lac insect. Of late, however, the use of this host for lac growing is being gradually discontinued in those areas.

Recently at the Indian Lac Research Institute, Namkum, research work on the possible utilisation of this as also of some other natural bushes and shrubs for lac cultivation has been undertaken with the object of introducing intensive cultivation of lac under agricultural

conditions and thereby reducing the cost of production of lac. One important advantage of working with this type of host is that cultivation of lac can be carried out in limited areas on a concentrated scale and climbing of trees either for inoculation or for cropping is avoided, which considerably reduces the cost of cultivation. Work has been carried out with *M. macrophylla* in particular, along two directions, namely, raising a plantation of these and their subsequent inoculation for lac growing. Results indicate that *M. macrophylla* shrub can be successfully raised through direct sowing of the seeds at a spacing of 6' × 6'. The shrub is ready for lac inoculation in about 2 years' time and regular lac cultivation thereafter leads to profuse tillering accompanied with a gradual increase in the size of the stool to 2' × 2'. These plants coppice well and it appears that the plants once raised can continue to serve as lac hosts for many years to come. At Namkum, the plants raised as early as 1952, yet continue to grow satisfactorily and give adequate yields of lac crops since their first inoculation in 1954.

Crop data obtained since then work out to an average yield of 3.6 (maximum variation 1.4-6.5) times the quantity of brood lac used, in the case of the *Katki* (June-July to October-November) crop, and to 2.3 times the quantity of brood used in the case of the *Baisakhi* (October-November to June-July) crop.

Recently investigations have also been taken up for growing *Kusmi* lac on this host by inoculating it with the *Kusmi* strain of the lac insects. Results obtained in the last two seasons indicate that this host has great potentiality as an alternative host for the *Kusum* tree (*Schleichera oleosa*). Successful crops can be grown on it particularly in the *Aghani* (June-July to January-February) seasons, the yield obtained being as much as 2 times the amount of brood used for inoculation. The progenies raised on this host with the *Kusmi* strain have continued to breed true for the three successive generations both morphologically and in durations of life-cycles. The colour of the resin obtained also is superior to that of the *Rangeeni* lac and conforms to that of the usual type of *Kusmi* lac.

However, this species being a natural shrub, is not able to support large numbers of lac insects during summer and hence the summer crop (*Baisakhi* or *Jethwi*) is not quite satisfactory, but with irrigation fairly satisfactory crops and brood yields may be obtained even during the summer. Its performance in the rainy season (namely, *Katki* and *Aghani* seasons) however, is quite good, and yields of lac sticks

up to a pound per plant can be obtained, using 3 to 4 oz. of brood lac for inoculation.

In view of the great demand from the consuming countries for better quality lac like that from the *Kusmi* strain, the utilization of this species as an alternative to the *Kusum* tree particularly for raising *Aghani* crops merits serious consideration. Further work is in progress to see how far this great promise based on our preliminary trials could be fulfilled *in toto*.

Indian Lac Research
Institute,
Namkum,
May 13, 1959.

S. KRISHNASWAMI.
B. K. PURKAYASTHA.
N. S. CHAUHAN.

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DIFFERENTIAL RESPONSE OF WHEAT VARIETIES TO N.P.K. AND THEIR COMBINATIONS

It is generally known that improved varieties of rice and wheat bred for high yield, resistance to common diseases and pests, differ amongst themselves in their nutritional requirements. Therefore when any improved variety is provided, it is necessary that its manurial requirement should also be known.

During the course of investigations carried out in Rabi 1957-58 at the Indian Agricultural Research Institute Farm, it was observed that among the two wheat varieties selected for study, N.P. 718 was found to be high yielding variety compared to N.P. 710 though the difference was not statistically significant. Out of three major plant nutrients, phosphate manuring increased the crop yield significantly. In case of N.P. 710, application of 20 and 40 lb. P_2O_5 /acre increased grain yield by 3.14 and 4.43 mds. while the corresponding increases in case of N.P. 718 were 3.19 and 4.32 mds. respectively. This indicated that the phosphatic requirement of both the varieties was almost of the same order. It was further observed that the variety N.P. 718 gave better response to levels of nitrogen than N.P. 710. Application of 20 lb. K_2O /acre reduced grain yield by 0.39 mds. in N.P. 710 and 0.67 mds. in N.P. 718 while 40 lb. K_2O /acre increased yield of N.P. 710 and N.P. 718 by 1.19 and 0.29 mds./acre respectively. This showed that N.P. 710 required more potash than N.P. 718. Beneficial effects on growth observations due to application of nitrogenous fertilizer was pronounced during 60-70 days

period while phosphate fertilizers gave highest increase during 75-90 days after sowing. Effect of potash was prominent during early tillering stage.

Division of Agronomy, M. M. P. SHRIVASTAVA.
Ind. Agri. Res. Inst.,
New Delhi-12, August 22, 1959.

NYCTOCEREUS SERPENTINUS Br. et R.—CEREUS SERPENTINUS D.C.

A CUTTING of the above cactus was planted in a ten-inch pot about ten years ago and placed near the wall of the courtyard. It slowly spread out and came in contact with the wall. The shoots formed branched adventitious roots and stuck to the plaster of the wall (Fig. 2). Some of these roots are over one foot in length.



FIGS. 1 and 2.

During the course of about ten years, the plant has occupied the wall area—12' × 8' (Fig. 1) and would have spread more had there been room and also had the original shoot been planted in the ground instead of in the pot. The roots, supporting the plant, have formed a thick mat stuck to the wall. It flowers in May-June and the flowers are about five inches long, funnel-shaped and white.

Economic Botanist (Retd.), T. S. SABNIS.
Govt. of U.P.,
Kanpur, August 21, 1959.

REVIEWS

Electricity, Magnetism and Atomic Physics. (Vol. II). *Atomic Physics*. By J. Yarwood. (University Tutorial Press Ltd., Clifton House, Euston Road, London N.W.1; India: Oxford University Press, Madras-2), 1958. Pp. viii + 644. Price 40 sh.

The present volume is a concise and at the same time a comprehensive text-book on Modern Physics dealing with the fundamentals of the study of electrons, ions, atomic structure and atomic radiations. As a companion to the earlier volume on classical Electricity and Magnetism, it is but natural that the historical development of the subject should be kept in view. Thus the classical quantum treatment of atoms and atomic spectra are dealt with in detail while the more fruitful method of wave-mechanics is confined to a single chapter which gives the main principles of this approach.

The book is divided into two almost equal halves, the first ten chapters being devoted to extranuclear phenomena and the remaining eleven chapters to radioactivity and nuclear phenomena including cosmic rays.

The book is up-to-date and includes latest topics which have been fairly well established in physical theories and as such should find an accepted place in a modern text-book.

The chapter on Nuclear reactors is particularly instructive and besides dealing with the principles involved in thermal reactors, it also gives brief details of the reactor at the Calder Hall Power Station.

The book is interspersed with worked examples and at the end of each chapter there are exercises and questions mostly taken from University papers. The sequence of treatment and the clarity of expression show that the book is written by an experienced teacher who is keenly aware of the needs and difficulties of examination-going students. The book will form an adequate text-book on Modern Physics for Honours and Degree students with Physics as the major.

The reviewer in his perusal of the book noticed a small error on p. 122, line 3 from bottom where 'm' in the equation is redundant.

The printing is bold and clear and the get-up is good.

A. S. G.

Structure Reports. Vol. XIV. General Editor. A. J. C. Wilson. (International Union of Crystallography), Pp. 215. Price. \$ 9.50.

The present volume represents, in the main, the cumulative index of structure reports for the years 1940 to 1950. The subject and author index are arranged alphabetically. In the formula index, the constituents are arranged in the alphabetical order of the chemical symbols. An additional index for carbon compounds is included, in which the primary classification is by the number of carbon atoms and the secondary classification is by the number of hydrogen atoms. A cumulative index for metals appears separately. A corrigenda for Volumes 8-130 appears at the end. The volume also contains a few actual structure reports. It may sound superfluous to elaborate on the usefulness of a cumulative index provided such an index has been compiled with care and forethought, as has been done in the present volume.

A. J.

Principles of Electronics. Second Edition. By H. Buckingham and E. M. Price. (Cleaver-Hume Press Ltd., London), 1958. Price 17 sh. 6 d.

This book, the ninth in the Cleaver-Hume Electrical Series, has a two-fold objective: to survey the fundamental processes of electronics and the theory and uses of the common electronic devices, and to describe the role of electronic apparatus and methods in engineering and industrial problems.

The first part of the book, after discussing atomic structure, radiation, electron emission, electron beams and semiconductor phenomena, describes the characteristics of vacuum and gas tubes, photo-electric tubes and cathode ray tubes, and traces the evolution of special purpose tubes such as the disc seal triode, the magnetron and the Klystron and the family of television camera tubes. The latter part of the book gives an exposition of the general principles of rectification, amplification, modulation and detection. Then follow a series of chapters dealing with practical applications: the use of photocells in illumination problems, in measurement and in industrial control; induction and dielectric heating; electric

welding; motor controls and register controls; measuring devices; electronic counters; proximity detectors; particle accelerators; and the electron microscope.

Mindful of recent progress in the subject, this second edition introduces two chapters dealing with magnetic amplifiers and transducers and junction rectifiers and transistors. In the interests of brevity, the explanations are somewhat oversimplified, but enough is said to arouse the curiosity of the reader and bring him an awareness of the many-sided advances that are taking place.

The book, though lucidly written, is not detailed enough to be prescribed for students in electronic engineering. But the material it presents will interest and greatly aid those to whom it is addressed, namely, students in electrical and other branches of engineering that have begun the use, on an increasing scale, of electronic methods and devices.

S. SAMPATH.

Indian Ephemeris and Nautical Almanac, 1960. (Published by the Manager of Publications, Civil Lines, Delhi). Pp. xxvii + 444. Price Rs. 14-00 or 22 sh.

The present issue of the Ephemeris for 1960 is a definite improvement over the first two issues for 1958 and 1959, and it is gratifying to note that in the preparation of this issue due attention has been paid to the most important shifts in international practice regarding the preparation of allied publications. Such an outstanding change introduced in this year's issue is the use of Ephemeris Time instead of Universal Time for the indication of the positions of the sun, moon and the planets. The short account given in the Introduction explaining the genesis of this change is very clear and convincing. Further improvements consist in the addition of ten new tables indicated on pp. v and vi of the Preface, accompanied by suitable explanations relating to them.

The section relating to the Indian Calendar has also been enriched by the addition of an extra table on pp. 420-21 giving the longitudes of the sun, moon and the planets for the period 1st January to 22nd March, 1961, in order to facilitate the preparation of Indian Panchangas for one complete Indian year. In this connection, one would naturally raise the question as to how far the publication of the Indian Ephemeris and Almanac for the last three years has helped in improving the accuracy of the several indigenous almanacs in the

country. We regret to say, however, that such an influence has been little or negligible as shown by the fact that many such almanacs in vogue in several parts of the country, which we recently had an occasion to see, are still hopelessly inaccurate even as regards fundamental data. It is, of course, unfair to expect the publishers of the Indian Ephemeris to undertake the task of reforming our indigenous almanacs, but it is desirable that an agency should be set up to undertake the introduction of these reforms.

A short review like this is not the proper place where one could indicate in detail the several improvements introduced in the present publication. It is nevertheless true that there are plenty of such improvements, and, in particular, the get-up, and the printing of the several tables are very well done. We hope that this excellent publication will be more widely used hereafter, and will serve as an incentive to the development of Indian Astronomy specially on the observational side.

B. S. MADHAVA RAO.

Chemical Analysis. Vol. III. (Colorimetric Determination of Traces of Metals.) Third Edition, Revised and Enlarged. By E. R. Sandell. (Interscience Publishers, Inc., New York-1), 1959. Pp. xxii + 1032. Price \$24.00.

Colorimetric methods for the determination of metal traces have found so many new applications and are so universally practised that an up-to-date survey of the subject as has been attempted in this volume is most welcome. This volume is divided into two parts, the first of which deals with the general aspects of inorganic trace analysis in a very readable manner while the second describes succinctly the procedures for 48 elements and the rare earths.

This book will be read with great interest and profit both by the beginner as well as by the advanced research worker and the professional analyst. The presentation of the subject-matter and the get-up are excellent but the price is rather high.

K. R. K.

Biochemical Society Symposia No. 16—The Structure and Function of Subcellular Components. (University Press, Cambridge, U.K.), 1959. Pp. 100. Price 15 sh. (Paper bound.)

The structure and function of Subcellular components edited by E. M. Crook (Cambridge

University Press, 1959) contains several important contributions summarising the prevalent concepts about the ultrastructure of cell membranes and the properties of the cell membranes with reference to transport of metabolites. In particular, the article by J. D. Robertson presents a fairly comprehensive compilation of the more recent developments in the field of cell membrane structure and is very stimulative, emphasising as it does, the somewhat speculative hypothesis that several cells have double membranes elegantly discernible by electron microscopy. Though the conclusions presented are largely derived from a detailed study of unmyelinated nerve fibres, they are probably of a more general significance, and suggest several lines of further investigation. The large number of diagrammatic representations and photomicrographs are very valuable. This is followed by an interesting article by S. J. Holt on the application of some promising cytochemical staining reactions for the study of intracellular enzyme distributions, based upon the use of indigoid dyes. Ernster's presentation of his more recent work on the distribution and interaction of enzymes is highlighted by his discussion of the relationship of Krebs' cycle enzymes to mitochondrial structure. "Structure and Function in Micro-organisms" by P. Mitchell is mainly concerned with the problems of active and passive transport of metabolites across microbial membranes and is notable for the lucid presentation of the general theories of membrane transport. The symposium concludes with an article by J. D. Judah and K. R. Rees on the changes in cellular components such as Diphosphopyridinenucleotide brought about by carbon tetrachloride injury. The book is well worth a careful study by all those interested in the relationship between cell structure and metabolism.

P. S. SARMA.

Proteins in Foods. By S. Kuppaswamy, M. Srinivasan and V. Subrahmanyam. (Special Report Series, No. 33.) (*Indian Council of Medical Research*, New Delhi), 1958. Pp. iii + 289. Price Rs. 12.00.

Proteins are important constituents of plant and animal cells. While plants synthesize proteins from simple inorganic elements of the soil, animals have to depend on ready-made proteins and their breakdown products. Dietary surveys in India show that the bulk of the food in Indian dietaries consists of cereals and pulses which supply about 80% of the total energy and are the major source of dietary

proteins. It has been reckoned that 10 to 14% of the calories in the diets of populations in economically advanced countries is contributed by protein. This level of protein calories is not likely to be reached in diets based predominantly on cereals, tubers and pulses which are consumed by large sections of the population in India. A better nutritional status can be achieved by placing before the people all available knowledge on the protein content and the protein quality of various food materials produced in respective localities so that they can intelligently select from among them the best possible balanced diet without incurring much additional cost to the family budget.

The present review on "Protein in Food" gives us information on protein contents of different food-stuffs including their nutritive value and amino-acid composition under each class of food-stuffs and a survey of the entire literature on the subject. Tables are given under each chapter in two sections, one on the nutritive value and the other on the essential amino-acid composition of the proteins in the food-stuffs. This is followed by relevant bibliography. In view of the importance of proteins in nutrition, the information given in this book will be of great value not only to the nutrition chemists and the dietetician but also to the average citizen in order to enable him to plan for his daily dietary in a befitting manner.

C. H. CHAKRABARTI.
M. C. NATH.

Patterns of Discovery—An Inquiry into the Conceptual Foundation of Science. By N. R. Hanson. (Cambridge University Press, London N.W. 1), 1959. Pp. 240. Price 30 sh.

The development of the subject of quantum mechanics has had a profound effect on the philosophical thought of the West in recent years. The new conceptual set-up has been variously discussed not merely by physicists but by professional philosophers as well. In this book, *Patterns of Discovery*, Professor Hanson has chosen to discuss some of the philosophical concepts in the light of the new situation in physics. The book is admittedly terse from the point of view of the physicist unaccustomed to philosophical thought. But the careful and the thorough manner in which it has been written, with examples to drive home difficult ideas, makes one take to it.

In the first chapter has been discussed the concept of 'observation'. 'Seeing' is not merely a physical state, a systematic exposure of the

senses to the world, but is an 'experience' involving organisation of what is seen. Also 'seeing this or that' threads knowledge into our seeing and the vital role played by the 'language' employed in this connection cannot be overemphasised. The next chapter dealing with facts, viz., the object of an experience, reminds us that the commonsense view of the facts as 'being or happening out there' is far from being true. It turns out on scrutiny that 'facts' are not picturable, observable entities, and are perhaps somehow 'moulded' by the logical forms of the fact-stating language, perhaps a mould in terms of which the word 'coagulates' in definite ways. The third chapter deals with 'causality', a much discussed topic in modern physics. The causal chain view has come in for criticism and it has been shown that this enquiry is, "theory-loaded" from the beginning. The so-called effects and causes (of which there are as many as the attempted explanations of the effects) are 'connected' only because our theories connect them and form items in an interlocked *pattern* of concepts. In the chapter on theories we are reminded that in his search for an explanation of data, the goal of the physicist is a conceptual *pattern* in terms of which his data will fit intelligibly alongside better known data. The method employed is not the method of deduction (which proves something must be), or the method of induction (which shows that something is actually operative), but the method of retrodution or abduction (*apagoge* of Aristotle) which suggests that something may be. A theory is a cluster of conclusions in search of a premise, a keystone idea from which the data are explicable as a matter of course, and it is built up in 'reverse' retroductively. The classical particle physics and the elementary particle physics, (the basic idea of the latter being "interaction") which occupy the last two chapters are examined against this background.

A careful study of the book would be of help both to the physicist and the professional philosopher. It may be pointed out, however, that many of the ideas advanced here call up to one's mind the profound discussion in Indian philosophy pertaining to topics such as *Pratyaksha* (Perception), *Anubhava* (Experience); *Vishayata* (Objectness), *Karyakarana Bhava* (cause and effect relationship), *Prakriyurachana* (building up of theories), *Paramanuvada* (Elementary particle theory), etc. Students of physics and philosophy would do well to remember Heisenberg's¹ observation,

viz. "Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of past centuries and we are compelled by the refinements of experimental art to consider them seriously" and to take to a study of these topics in the manner of the previous generations and estimate modern physical thought in the light of such studies.

D. S. SUBBARAMAIA.

The Coconut Palm—A Monograph. By K. P. V. Menon & K. M. Pandalai. (Published by the Indian Central Coconut Committee), 1957. Pp. 357. Price Rs. 38-00.

The present publication is the outcome of the commendable programme of the Indian Council of Agricultural Research and its Commodity Committees initiated by Dr. M. S. Randhawa, the Vice-President, to bring out a series of critical monographs on the important crops of India. The publication brings together all information available on various aspects of coconut palm including its morphology, anatomy, cytology, physiology, cultural practices and the control of pests and diseases. With the establishment of Coconut Research Stations several years ago at Kasargod and Kayangulam, India has contributed much to our present knowledge of this valuable tree crop, and the excellent publications of Sampson in 1923 and Patel in 1938 had become out of date. The present monograph has not only utilised the information available in these previous publications, but has also brought up-to-date results obtained since then. Although coconut is an important crop of India, it is also grown extensively in other countries like Ceylon, the Philippines, New Guinea, Trinidad and Jamaica. Considerable work is also being done on scientific aspects of coconut in these countries and the present monograph includes the results obtained also in these countries. It can, therefore, be said that the objective to consolidate all available facts pertaining to the coconut in a single publication has been achieved.

The book itself is divided into 18 Chapters dealing with the different investigations that have been in progress. The first four chapters deal with the palm, its original home and its botany. Chapters four, five and seven deal with what is at present understood as varieties, their classification, breeding and production of quality material. The chapter on breeding is, however, brief and could have been dealt in greater detail. Perhaps the controversy that exists about the

1. Physical Principles of the Quantum Theory.

application of regular breeding practices to this tree crop has made the authors rather conservative in their outlook. One may not entirely agree with the views expounded by Dr. Harland with regard to breeding of coconut. A critical examination of the available data, both in India and in some other countries where investigations have been in progress, might perhaps show that selection of mother trees as it is advocated and practised has provided profitable results, and it is learnt that such a study undertaken in Ceylon does seem to indicate that selection of individuals for number of nuts and nut-weights can be effective. There is no doubt, however, that the improvement of this tree plant should be taken up seriously and on proper lines.

Chapter five on climate and soil conditions could well have been dealt in the beginning or at least before discussing varieties and breeding.

Information on cultural practices in the field, soil conditions, plantation management, yield, etc., are discussed in the next five chapters. They are fairly exhaustive and provide information of practical value not only to technicians engaged in scientific investigations, but also to actual coconut growers.

The diseases and soil conditions in relation to health and disease are discussed in the subsequent two chapters. Investigations have emphasized how complicated the disease problem is, and how it has to be attacked from a wide angle including the soil, the physiology of the palm and its nutrition, viruses, nematode, etc. The chapter on pests is, however, much more critical and contains valuable information on the chief insect pests and methods that have been developed for their control.

The next three chapters deal respectively with tapping, abnormalities and utilisation of coconut products. Perhaps the chapter on abnormalities could have been treated next to the botany of the palm. The concluding chapter on certain problems in coconut research discusses the present position of our knowledge and indicates where all lucuma exists needing further studies and investigations.

The book contains a large number of good illustrations and coloured plates which add to the attractiveness of the volume and incidentally also to its cost. The objectives of this publication is to bring together technical information for the benefit of investigators and technologists and the Coconut Committee could not have made it any cheaper. Perhaps a sister volume embodying the main practical principles of coconut growing can be written for the use of actual growers.

The authors have been associated with coconut research for nearly two decades and the treatment of the material available could not have been in better hands. The information available all over the world has been well compiled and the only criticism, if it is a criticism at all, can be that the authors could have been a little more critical in assessing the value of information compiled.

K. R.

Books Received

- Jets and Rockets.* By A. Barker, T. R. F. Nonweiler, R. Smelt, 1959. Pp. xiv + 268. Price 35 sh.; *Metal Fatigue.* Edited by J. A. Pope, 1959. Pp. xiv + 381. Price 70 sh.; *Aircraft Electrical Engineering.* Edited by G. G. Wakefield, 1959. Pp. xiv + 349. Price 50 sh. (Chapman & Hall Ltd., London W.C. 2; India: Asia Publishing House Bombay-1).
- Heterocyclic Chemistry, an Introduction.* By A. Albert. (The Athlone Press, 2, Gower Street, London W.C. 1), 1959. Pp. viii + 424. Price 45 sh.
- Plant Diseases, Their Causes and Control.* 2nd Revised Edition. By S. Chowdhury. (Kitabistan, Allahabad), 1958. Pp. 106. Price Rs. 3-50.
- Blood Groups—British Medical Bulletin*, Vol. 15, No. 2, May, 1959. (The British Council, London W. 1), 1959. Pp. 89-173. Price 20 sh. (Dover Publications, New York-14), 1959.
- Magnetic Sound Recording.* By D. A. Snel. (Philips Tech. Lib., Eindhoven; India: Philips India Ltd., Calcutta-20), 1959. Pp. xii + 217. Price Rs. 12-00.
- The Harvey Lectures, 1957-58.* (Academic Press, New York 3), 1959. Pp. xiv + 254. Price \$ 7.50.
- Methods of Biochemical Analysis.* Vol. 7. Edited by D. Glick. (Interscience Pub., New York-1), 1959. Pp. ix + 353. Price \$ 9.50.
- Electronic Digital Computers.* By C. V. L. Smith (McGraw-Hill Book Co., London E. C. 4), 1959. Pp. ix + 443. Price \$ 12.00.
- Nuclear Magnetic Resonance—Applications to Organic Chemistry.* By John D. Roberts. (McGraw-Hill Book Co., London E.C. 4), 1959. Pp. viii + 118. Price \$ 6.00.
- Principles of Modern Physics.* By Robert B. Leighton. (McGraw-Hill Book Co., London E.C. 4), 1959. Pp. xi + 795. Price \$ 12.50.
- Advanced Calculus.* By Edwin Bidwell Wilson. (Dover Publications, New York-14), 1959. Pp. ix + 566. Price \$ 2.45.

SCIENCE NOTES AND NEWS

Award of Research Degree

The Agra University has awarded the Ph.D. Degree in Chemistry to Shri Vishnu for his thesis entitled "Physico-Chemical Studies on Polycomponent Saccharine System".

The Gujarat University has awarded the Ph.D. Degree to Messrs. T. S. G. Sastry, R. N. Kulkarni and Satya Prakash for their theses entitled "The Time Variation of Cosmic Rays at Low Latitudes", "Studies on Atmospheric Ozone" and "Studies in Cosmic Rays" respectively.

The Karnatak University has awarded the Ph.D. Degree in Physics to Shri K. S. Raghavendra Rao for his thesis entitled "Problems of Molecular Spectra-Studies on Active Nitrogen".

The Utkal University has awarded the D.Sc. Degree in Chemistry to Shri Mahendra Kumar Raut for his thesis entitled "Studies on Heterocyclic Compounds".

Birbal Sahni Institute of Palaeobotany,
Lucknow

The twelfth annual scientific meeting of the Palaeobotanical Society will be held at the Institute's premises on the 22nd and 23rd of January 1960. The programme chalked out includes lectures, reading of papers and discussions. Palaeobotanists from all over India are expected to participate.

Meeting of Commission on Ecology

Commission on Ecology of the International Union for the Conservation of Nature and Natural Resources is arranging a meeting of the Commission at Warsaw from 14th to 29th June 1960. Discussions will be centred on the following three themes: (1) The Impact of Man and Modern Technology on Nature and Natural Resources; (2) Management of Wild Grazing Animals in Temperate Zones and its Relation to Land Use; (3) Ecological Effects of the Biological and Chemical Control of Undesirable Plants and Animals.

Any scientist desirous of presenting paper on any of the above themes may please contact Dr. G. S. Puri, Member of the Commission on Ecology, IUCN, Botanical Survey of India, 7, Koregaon Road, Poona-1, for further information.

Silver Jubilee of the Department of Chemical
Technology, University of Bombay

The Bombay University Department of Chemical Technology has completed 25 years of its useful work and the Silver Jubilee of its foundation will be celebrated in the first week of January 1960. The Department is fully equipped for chemical and technological research, and from the earliest stages of its development research played a very important part. The Department has done pioneering work in the field of Dyestuff Technology. Besides 400 degree students, there are about 125 research workers including candidates for the degrees of M.Sc. (Tech.) and Ph.D. The Department enjoys a number of endowments from individuals, corporations and industrial firms.

To commemorate the occasion a Silver Jubilee Fund is created which will be utilized to improve research facilities and student welfare activities.

UNESCO Symposium on 'ALGOLOGY'

An international symposium on 'ALGOLOGY' will be held at the Indian Agricultural Research Institute, New Delhi, during 7-12 December 1959, under the joint sponsorship of the Indian Council of Agricultural Research and UNESCO. Main Topics which will be discussed are nitrogen fixing algæ, edible algæ and their mass culture.

UNESCO has invited to the symposium Dr. G. E. Fogg, London, Prof. Dr. Hiroshi Tamiya, Japan and Prof. Dr. H. V. Witsch, Fed. Rep. (Germany). In addition UNESCO has extended invitations to the Governments of Afghanistan, Burma, Ceylon, India, Nepal and Pakistan, to send a participant each. F.A.O. may also send an expert. The symposium will bring together about 120 scientists and 30 papers are scheduled for presentation.

Enquiries about the symposium should be addressed to the UNESCO South Asia Science Co-operation Office, 21, Curzon Road, New Delhi, India.

New Radio Telescope in Australia

Australian research in radio-astronomy will be extended by the construction of the big new radio telescope, which is to be erected at Parkes, New South Wales, at a cost of nearly £ 750,000 (see *Curr. Sci.*, 1957, 26, 371). A contract had

been placed with a German firm for the construction of the telescope. International interest in the project is shown by the financial assistance received from the Rockefeller Foundation and the Carnegie Corporation, and the fact that details of the design were worked out by the British firm of consulting engineers, Messrs. Freeman, Fox and Partners, in collaboration with Dr. E. G. Bowen of the C.S.R.O.

The "mirror" which collects and focusses incoming radio waves will be a bowl-shaped steel structure 210 feet in diameter, and covered with wire-mesh. Although slightly smaller in diameter than the British telescope at Jodrell Bank, the Parkes instrument will embody many improvements which will result in higher precision, smoother movement and a general all-round increase in efficiency.

Atomic Reactor at the Agricultural Fair in New Delhi

The U. S. Atomic Reactor TRIGA (see *Curr. Sci.*, January 1959, p. 11) will be a feature attraction at the First World Agricultural Fair opening in New Delhi, on December 14, 1959. It will give visitors to the Fair an unusual opportunity to see nuclear research in action demonstrating one of the peaceful uses of atomic energy, namely, in the field of agricultural research. There will be spot experiments to demonstrate the use of radio-isotopes, produced by TRIGA, in the improvement of crop strains and yields, in the control of pests of plant and animal diseases.

The TRIGA which will be in operation for the two months of the Fair in New Delhi, is similar to the one which was demonstrated in September 1958, in Geneva, at the International Conference on the Peaceful Uses of Atomic Energy. Besides the operating TRIGA reactor, there will also be a full size cutaway model of its nuclear core providing a close up view of its irradiation facilities and its fuel moderator elements, of uranium-zirconium hydride.

It is stated that Indian scientists will be invited to operate the TRIGA and work side by side with American personnel from the John Jay Hopkins Laboratory.

Fossil Indicator Checked

The ratio of oxygen-18 and oxygen-16 in fossils indicates the temperature of the water when the fossils were laid down. H. A. Lowenstam, California Institute of Technology, reported that he has confirmed the validity of this technique by studying magnesium and

strontium contents of calcium carbonate remains. The identity of results of the three methods suggests that the magnesium and strontium intake of specimens 250 million years old was the same as today's; thus the chemical composition of sea-water has remained unchanged during this time. Lowenstam is now working on specimens 400 million years old.—*ISLO Newsletter*.

Astronomical Gamma Rays

From radio telescope studies it is known that two particularly large sources of radiant energy are the Crab nebula and the stellar object called Cygnus A. The Crab nebula is probably the remains of a supernova explosion while the source in Cygnus may be a large-scale collision between matter and anti-matter. On the basis of these two hypotheses, M. P. Savedoff (*Nuovo Cimento*, Vol 13, p. 12) has calculated the flux of γ -rays that might be expected from them at the Earth's surface. He concludes that the Crab—assuming that the radiation would come from the radioactive decay of Californium—might provide seven γ -rays per sq. cm., per hundred thousand (10^5) seconds (about 2½ hours) and that four γ -rays/cm.²/10⁵ sec. should be received from Cygnus, from the decay of the meson. Since it has been estimated that suitable stacks of oriented nuclear emulsion film might discriminate a flux of five γ -rays/cm.²/10⁵ sec., Savedoff believes that experiments with such stacks might be able to test the truth of the two hypotheses.

Transistors for Hot Zones

A novel method has been devised to obtain single crystals of very pure silicon carbide. Transistors made from such crystals promise to work at very much higher temperatures than do those currently in use which employ germanium or silicon as the semiconducting element: 1,800° F., compared with Circa 200° to 450° F.

The method involves melting pure silicon in a carbon crucible. In due course the carbon diffuses into, and saturates, the solution. Careful temperature control is exercised to introduce a cool region in the solution where a single crystal of silicon carbide can then be grown.

Semiconductor materials prepared by this method should prove useful in applications where the environment is hot or where there is a problem of heat dissipation such as may occur in complex electronic equipment embodying very small components.—*ISLO Newsletter*.

How Vitamin B₁₂ Works

Dr. A. Sreenivasan *et al.*, of the Department of Chemical Technology, Bombay, report new work on protection of the body by Vitamin B₁₂ in particular in cases of over-active thyroid and liver poisoning (*Biochemical Journal*, Vol. 72, pp. 374 and 384).

They have examined how B₁₂ reserves in the tissues help to repair the damage done to the mitochondria, the small bodies in living cells active in respiration processes. Their work suggests that B₁₂ influences the level of compounds containing a sulphur-hydrogen group, for instance glutathione. They therefore suppose that it is this control by B₁₂ which in turn keeps the mitochondria in good metabolic condition.

Support for this view comes from their work on rats, in which they caused liver damage by administering carbon tetrachloride. The livers were depleted of glutathione, ribonucleoprotein and phosphorous compounds, while fat accumulated. Vitamin B₁₂ afforded protection against these conditions by its effect upon the mitochondria.

Alloying Steel with Tellurium

In recent years tellurium has been used as an alloying element in cast iron, where it prevents chilling, and in view of its great effectiveness investigations have been carried out to study its effect on steel. A structural steel with 0.4% carbon content (0.18% silicon and 0.7% manganese) was produced and alloyed with varying amounts of tellurium—from 0.06% to 1%. The resulting specimens were then subjected to various tests such as static strength, impact strength, hardenability and grain growth.

When the non-alloyed steel was heated to 1,200° C. and slowly cooled down, its impact strength dropped to less than half of the usual value. An addition of only 0.014% tellurium was sufficient to maintain the full impact strength. It was also found that tellurium greatly retards grain growth in heating up to 1,150° C. Another effect is a considerably reduced hardenability. With a tellurium content above 0.015% the static properties of the steel were somewhat lowered, but this could be countered by introducing 0.1% cerium. In this

manner a structural steel containing a small amount of tellurium (and preferably also cerium) becomes less susceptible to the effect of overheating and hardens to a smaller depth than an unalloyed one, and can be safely used for induction-hardened components, which at present have to be made from carburised steels.

Electromagnetic Detector for Locating Ore Deposits

A new type of airborne electromagnetic apparatus working on the principle of the wartime mine detector is expected to afford greater sensitivity in searches for mineral deposits.

The principal components of the detector are a transmitter, a receiver and a recorder. The aeroplane has a pod on each wingtip. The transmitter produces an alternating magnetic field in a tuned coil in the starboard pod. This induces a voltage in a second coil housed in the port pod connected to the receiver.

When the aircraft is flying beyond the range of ground influences, the induced voltage in the receiving coil is balanced by a current of equal magnitude but opposite phase derived from a secondary winding on the transmitting coil. If the unit passes over a big conducting ore-body, however, eddy currents are induced in the body and these alter the magnetic field in the receiving coil, producing an unbalance signal. By amplifying and resolving this signal, the system can be made to distinguish between zones of conducting minerals and areas of poor conductivity like swamps and saline overburden.

Although the idea of locating ores by electromagnetic methods is not new, it has not always been easy to discriminate between swamps and potentially valuable sites such as deposits of metallic sulphides. The new system is thought to be superior in some ways to earlier detectors using two frequencies and recording only the in-phase component. Now a single frequency is employed and both in-phase and out-of-phase components are measured so that a varying phase shift is obtained, according to the conductivity of the ore-body. Since the coils are mounted on the wingtips, the signal does not wander as has been known to happen when the coil is fixed to a drogue towed behind the aircraft.—*ISLO Newsletter*.

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Business correspondence, remittances, subscriptions, advertisements, exchange journals, etc., should be addressed to the Manager, Current Science Association, Bangalore-6.

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LIGHT, COLOUR AND VISION*

SIR C. V. RAMAN

OUR eyes enable us to perceive the world around us, and they are, therefore, amongst our most precious possessions. What they accomplish is such a familiar experience that we cease to be conscious of the remarkable nature of the services which they render. I propose, in this lecture, firstly, to draw your attention to some of the outstanding features of our visual powers, and then to recount to you how they have been sought to be explained. The subject is so extensive in its scope that I cannot hope in the course of an hour's lecture, to do more than sketch very briefly, the explorations that have been made in this field of knowledge in past years and continue to be made at the present time.

Surveying the facts of visual experience, we may group them under three heads: firstly, we may remark upon the enormous range of the intensities of light to which the eye can adapt itself and yet function with comfort. From the brightest sunshine to the dim starlight of a clear but moon-less night is a step-down in intensity by a factor of a hundred million, but one can nevertheless see well enough in either case, to keep to the path on a country-side walk. Indeed, the measurements, which have been made of the power of the eye to detect feeble light have shown that for very brief exposures, the human eye is several thousand times more sensitive than the fastest photographic emulsions so far produced. Secondly, we may remark upon the power of our eyes to adjust themselves for viewing objects which are either far or near, upon their power to judge the form and distance of the object's appearing in the field of vision, and to estimate their positions relatively to each other, as also to detect their movements. Then again, when attention is fixed on any limited area in the visual field, our eyes can perceive and recognize very fine details. Thirdly, we may remark upon the ability of our eyes to recognize and distinguish the characters of an illuminated object which may be described respectively as its brightness, its hue or colour, and the degree of saturation or purity of that colour. If all these three attributes are taken simultaneously into consideration, the number

of possibilities between which our eyes can discriminate is extremely large.

The incidence of light from external objects on our eyes and our perception of these objects are the two ends of a connected set of processes: firstly, the functioning of the eye as an optical instrument which forms images of external objects on the retina; secondly the functioning of the retina as a receptor of radiant energy; thirdly, the transmission of the messages originating at the structures of the retina to the visual centres in the brain, and finally the integration of the messages received from the retinae of both the eyes into a visual picture exhibiting various characteristic features, viz., form, depth, detail, brightness, colour, and movement. The importance of the role which binocularity plays in the phenomena of vision needs to be stressed. It is very strikingly illustrated by the known facts of colour vision; when a picture of an object printed in complementary colours in stereoscopically displaced positions is viewed through complementary filters placed before the two eyes, one perceives a single picture in relief, but exhibiting no colour whatever.

2. THE EYE AS AN OPTICAL INSTRUMENT

Leonardo da Vinci was the first to propose a rational theory of the functioning of the eye. He compared it with that of the *camera obscura* and assumed that an image rendered sharp by the lens was formed on the internal cavity of the eye. Indeed, it is the case that the eye is built in several respects like a photographic camera. It is approximately spherical in shape, and is covered by a fibrous tunic which is white and opaque for the most part, but has a transparent protuberance in front which is of greater convexity than the rest. These two parts of the eye are known respectively as the sclera and the cornea. The darkening of the interior necessary in a camera is secured by the presence of the chorioid coat which is a membrane traversed by numerous blood vessels and abundantly pigmented. The chorioid clings closely to the sclera and absorbs the unwanted rays. Against the inner surface of the chorioid coat lies the part of the retina which is sensitive to light. A further analogy with a camera is provided by the eyelids, which, acting like a shutter, can be closed to exclude light. Likewise, when light is admitted, it is

* Gandhi Memorial Lecture delivered on Friday, the 2nd October 1959, at the Raman Research Institute, Bangalore.

regulated in amount by the variation of the size of the pupil which corresponds to the variable aperture of a photographic camera.

The interior of the eye is not empty, but is filled with transparent media known as the aqueous humour and the vitreous body which fill respectively the front and the back of the cavity. Their refractive indices (1.336) differ very little from that of pure water. Behind the iris lies the lens of the eye. Both of its surfaces are convex, the front less so than the rear. The refractive index of the lens varies from the centre to the periphery; its effective value is 1.42. Since however, the lens is immersed in a medium of which the index is 1.336, its converging action on the light is greatly reduced thereby, and only supplements that produced by the front surface of the cornea. The principal function of the lens is to enable the eye to accommodate itself for near or distant vision as required. This is brought about by the action of the ciliary muscles on the capsule which is an elastic membrane completely enclosing the lens; the force thus exerted on the material of the lens enables the curvature of its front surface to be increased for near vision as compared with the normal state of the eye when viewing distant objects.

The shape of the eye-ball is maintained by the action of what is known as the intra-ocular pressure, viz., the hydrostatic pressure of the fluid filling the cavity of the eye. Fresh fluid is continually added to the aqueous humour and is continually drained away from it into the blood stream by a complex arrangement which is so regulated that the pressure of the fluid within the eye remains roughly constant. Since, as already remarked, the external surface of the cornea plays the leading role in the work of the eye as an optical instrument, it is not surprising to find that provision exists for protecting the corneal surface and maintaining it in good condition. This, indeed, is the function of the eyelids and the lacrimal apparatus. The periodic blinking of the eyes serves the purpose of cleaning and wetting the cornea.

The effective functioning of our eyes is to a very great extent dependent upon certain accessory structures associated with them. The eye-ball is located within the cavity known as the orbit and its movements are controlled by three pairs of muscles which enable the eye to be directed towards any particular object in the field of vision. The construction of the eye makes it possible to have a very large angular field of vision. This, for each eye

separately, is about 160° laterally and 120° vertically, and for both eyes together, somewhat more than two right angles from left to right. It is, of course, not to be expected that the image of external objects formed on the surface of the retina would everywhere be sharply focussed. Indeed it is only over a very small fraction of the whole field of view that the image on the retina is well defined and sharp. When we direct our eyes towards an object, we make use of this well-defined part, which, as we shall see presently, falls on the region of the retina which is best equipped for the discrimination of fine detail in the image.

A question of some interest is the reason why the effects of chromatic aberration on our vision are scarcely noticeable in normal circumstances. The explanation is that the refractive media of the eye have very small dispersive powers. Further, the sensitivity of the eye to radiation exhibits a maximum spread over a narrow region of the visible spectrum. This circumstance would tend to minimise any visible manifestations of chromatic aberration. They can however be observed when a small, bright source of light is viewed through a colour filter which transmits only the two ends of the visible spectrum, viz., red and violet respectively.

3. THE STRUCTURE OF THE RETINA

The retina is a delicate membrane which is specially adapted for the reception of light stimuli. In the fresh state it is soft, translucent, and of a purple tint, owing to the presence of a colouring material named rhodopsin or visual purple. Near the centre of the retina there is an oval yellowish area, named the *macula lutea* where the visual sense is most perfect. This shows a central depression which is termed the *fovea centralis*, where the retina is exceedingly thin, some of its layers having practically disappeared, and the dark colour of the chorioid is distinctly seen through it. About three millimetres to the nasal side of the *macula lutea*, the optic nerve pierces the retina at the optic disc which has a diameter of about 1.5 millimetres. The centre of the disc is pierced by the central artery and the vein of the retina. The optic disc is insensitive to light and is termed as the blind spot.

The retina itself consists of several layers of cells. The first is the pigmented epithelium which is firmly joined to the inner surface of the chorioid coat. Next comes the retina proper or the visual layer containing the receptor cells and their nuclei. The receptors are recognized

as being of two kinds known respectively as the rods and the cones. They both consist of elongated cells which point towards the chorioid coat, and the light entering the eye has accordingly to pass through the remainder of the retina to reach them. The impulses originating at the visual layer are then transmitted to the optic nerve through the outer layers termed collectively as the bipolar and ganglionic layers. The outermost layer of the retina in contact with the vitreous body is the *stratum opticum*. It consists of the nerve fibres formed by the expansion of the optic nerve over the surface of the retina. They are connected with the visual cells through the bipolar and the ganglionic layers. The human retina contains some six million cones and over a hundred million rods, whereas the optic nerve contains only some 8,00,000 nerve fibres. It follows that some tens and sometimes even hundreds of receptor cells must be connected to a single ganglion cell by way of the bipolars. An exception, however, appears to exist in respect of the *fovea centralis*. Here there are no rods and the cones are longer and thinner than in the other parts of the retina. Each cone in this area is connected separately by way of a monosynaptic bipolar to an individual ganglion cell and this enables it by means of the corresponding fibre of the optic nerve (which is simply the axon of the ganglion cell) to act individually at the cortical centre. It is in this manner that the high degree of visual acuity or power of discrimination possessed by the central area of the retina has been explained.

4. THE DUALITY OF THE VISUAL PROCESS

When a person quits the sunshine out of doors and enters a dark room, he can see nothing at first. His eyes then slowly adapt themselves to darkness, and in about half an hour, he becomes fully sensitive to the faint illumination present and can distinguish the various objects around. Conversely, when a person who has been long in darkness comes out into the light, the reverse process of adaptation to a high level of illumination takes place, but this is a much quicker process. These and other well-established facts indicate that the human eye possesses two retinæ interlaced with each other. One is a day-retina, which has a low sensitivity to light, can perceive differences in colour, and possesses (at least in its central regions) a high degree of visual acuity. The other is a night-retina which has a high sensitivity to light, but lacks appreciation of differences in colour and exhibits a very low visual acuity. So striking are these differences that it is found convenient to

give the name of photopic vision to the function of the day-retina and scotopic vision to that of the night-retina.

As remarked above, the sensitivity of the eye to light differs enormously in photopic and scotopic vision. Its variation with wavelength over the visible spectrum has been investigated for both types of vision. A pronounced maximum somewhere in the middle of the spectrum is exhibited in both cases. But the positions of this maximum differ notably, being 557 m μ for photopic and 510 m μ for scotopic vision. If the two curves of spectral sensitivity are drawn in such manner that the ordinates of the maximum are the same in both, the photopic curve lies well above the scotopic in the red, orange, and yellow regions of the spectrum and well below it in the blue and violet regions. This difference is responsible for the well-known and easily observed Purkinje phenomenon which may be stated briefly thus: the relative brightness of two objects, coloured red and blue respectively, changes in a most striking fashion when the light which illuminates them falls off from a high to a low intensity.

It is reasonable to ascribe photopic vision to the activity of the cones in the retina as receptors of light, while scotopic vision represents the functioning of the rods. The characteristic differences between the two types of vision in respect of sensitivity and acuity can be explained on this basis. As already stated, the rods in the retina are far more numerous than the cones and their number is enormously larger than the number of separate nerve fibres connecting the retina with the cerebral centre. Rod vision, therefore, arises from the co-operative effect of a great many of them functioning together and this would, at least in part, explain its characteristic features. The absence of rods in the foveal region of the retina and their presence elsewhere would indicate that sources of light which are too faint to be seen when viewed directly would be visible in averted vision. This, indeed, is a fact of observation, as for example when faint groups of stars are looked for at night in the sky.

5. THE PHENOMENA OF COLOUR VISION

Colour plays such an important role in so many different types of human activity that it has naturally been the subject of intensive investigations from many different points of view. The sensations produced by coloured light may be described as presenting three distinct subjective characters, *viz.*, brightness, hue or colour proper, and the degree of saturation

or purity of the colour. The pure colours we are acquainted with are the colours exhibited by a well-resolved spectrum. These range from red to violet but the eye can distinguish a great many different colours between these extremes. The question naturally arises how the colours we meet with in nature or can be artificially produced, are related to the pure spectral colours.

We may begin by stating a few well-established facts of observation. By superposing appropriate amounts of a pure spectral red, say $700\text{ m}\mu$ and a pure spectral green, say $546\text{ m}\mu$, it is possible to reproduce any other colour appearing in the spectrum within this range of wavelengths. Then again, for any given spectral colour lying in the region between the red and the yellow, it is possible to choose a corresponding spectral colour lying in the range between greenish-blue and violet so that appropriate amounts of the two when superposed would result in a pure white. On the other hand, it is not possible to find a spectral colour complementary to radiations in the green region of the spectrum. Then again, by the superposition of spectral colours lying respectively at the red and violet ends of the spectrum, a series of colours are produced which are not observable in a pure spectrum, *viz.*, the purples.

Finally, it may be remarked that by mixing three selected spectral colours in definite proportions, we may match any desired colour sensation. This is the fundamental law of colour vision which has however to be understood in a special sense, *viz.*, that in certain cases the addition is to be replaced by a subtraction. Why this is so can be readily understood if we represent the three selected spectral colours by the vertices of a triangle and the colours obtained by superposing them by points inside the triangle. Taking the three selected spectral colours to be $700\text{ m}\mu$ (red), $546\text{ m}\mu$ (green), and $436\text{ m}\mu$ (blue), pure white would correspond to a point at the centre of the triangle, while other colours drift away from the centre in a direction represented by the dominant hue and to an extent which expresses its purity or saturation. But colours closely approximating in purity to the colours lying between the green and violet in the spectrum would lie outside such a triangle. Hence one would have to add to the colour under study a suitable amount of its complementary and thereby diminish the saturation or purity of the resultant to make it the same as the mixture of two colours compared with it.

The foregoing statements refer to the facts of colour vision as normally observed. Anomalies of colour vision are however exhibited by certain individuals, and these have been very thoroughly investigated by reason of their interest in relation to theories of colour vision. Persons whose colour vision is anomalous may be classified into three groups, *viz.*, anomalous trichromats, dichromats, and monochromats. Anomalous trichromats are those who need, in general, three component stimuli to match any given colour, but their proportions are different from those for normal observers. Dichromats are those who require only two component stimuli; while monochromats are subjects who see only variations of brightness and are unable to recognize any colour.

6. PHOTOCHEMISTRY OF THE RETINA

The principal characteristic of the reaction of the retina to light is its extreme selectivity as regards wavelength. In view of this, the only reasonable explanation of the sensitivity of the retina to light that has been proposed is one based upon the photochemical action of light. In other words, light is absorbed by a coloured substance associated with the receptor cells and induces a change in the substance; this in its turn sets up or gives rise to an electrical displacement or potential which is taken up and transmitted by the nerves as an impulse to the cortical centre. For such a theory to be sustainable, the photosensitive substance has to satisfy a number of requirements. It must be stable in the dark and after being altered or destroyed by light should be capable of being regenerated so that the receptor could continue to be light-sensitive.

As mentioned earlier, the retina in the fresh state exhibits a purple tint. But when exposed to light it becomes clouded, opaque, and bleached. Thus it is natural to assume that the colouring matter present in the fresh retina known as rhodopsin or visual purple is the photosensitive substance which enables the transformation of light into some other form of energy capable of acting directly on the nerves. A substantial proof of the correctness of this view came to hand when the light-absorption curve of human visual purple was determined and its resemblance to the scotopic curve of luminous efficiency in the spectrum was revealed. In other words, rhodopsin or the visual purple is indicated as the agent responsible for the activity of the rods in the retina as receptors of light radiation. The loss of the sensitivity of the eye to weak illumination in bright daylight and

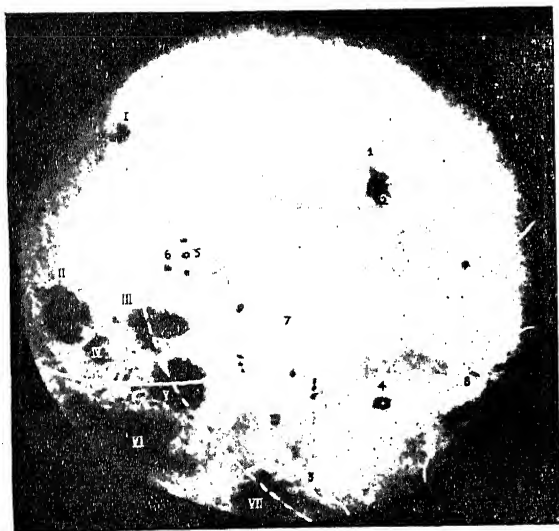
its restoration when the subject remains in the dark for long periods is explained on the basis that the exposure to strong light bleaches out the rhodopsin and that this is regenerated in darkness after a sufficient period of time.

Quite naturally, therefore, one is led to suppose that the sensitivity of the cones in the retina also arises from the presence of other photosensitive pigments in them. Experimental evidence supporting this view has been adduced by W. H. Rushton in a recent remarkable investigation. He has developed a technique for measuring the pigment present in the fovea

by analyzing the light reflected from it and observed in an ophthalmoscope. Observations were made by him with normal trichromatic individuals and as also with a dichromat who was rather insensitive to red light. It was found that the fovea on exposure to bright light bleaches and darkens again during the next few minutes. Evidence is forthcoming from the observations that the normal fovea contains two visual pigments, one of which is green-sensitive and the other is red-sensitive; the former alone was found to be present in the fovea of the dichromat.

PHOTOGRAPHS OF THE MOON'S HIDDEN SIDE FROM LUNIK III

THE first pictures of the hidden side of the moon taken by the Russian Automatic Interplanetary Station and transmitted to earth were released for publication on October 26, 1959. The photographs were taken with a two-unit camera, each unit of which had a different optical system enabling simultaneous pictures to be taken on two different scales. One camera with its lens of 200 mm. focal length gave an overall picture of the moon, while the other with the 500 mm. focal length lens gave a more detailed picture of a part of the lunar disc.



The position of objects on the side of the Moon invisible from the Earth obtained after the preliminary development of the photographs received from aboard the automatic interplanetary station: 1. Large crater sea with a diameter of 300 kilometres—the Sea of Moscow; 2. Bay of Astronauts in the Sea of Moscow; 3. Continuation of Mare Australe on the reverse side of the Moon; 4. Crater with central peak—Tsiolkovsky; 5. Crater with central peak—Lomonosov; 6. Crater Joliot-Curie; 7.

Sovietsky Mountain Range; 8. Sea of Dreams. The unbroken line running across the picture is the lunar equator. The line of dashes shows the border between the parts of the Moon visible and invisible from the Earth. The details established with certainty after the preliminary development of the photographs are surrounded by an unbroken line. The lines of dashes around various spots show that their shape needs to be ascertained. Dots around objects show that their classification is being determined. As regards the remainder, the treatment of the photographic material is being continued. Roman figures indicate details on the visible part of the Moon: I—Mare Humboldtianum; II—Mare Crisium; III—Mare Marginis, with a continuation on the invisible part of the Moon; IV—Mare Undarum; V—Mare Smythii, with a continuation on the invisible side of the Moon; VI—Mare Fecunditatis; VII—Mare Australe, with a continuation on the invisible side of the Moon.

The photographing was done on a special 35 mm. film, and automatic developing and processing of the exposed part of the film went on while photographs were still being taken. In fact the clicking of the camera and later transmission of the picture marked the beginning and end of a cycle of operations automatically controlled by a system of electronic and electromechanical devices contained within the satellite. The photographs were transmitted to earth by television but at a much slower rate than that used in conventional TV. The reception of the television signals from the satellite's tele-transmitter whose emission power was only a hundred millionth part that of an ordinary TV set, was picked up by specially sensitive receivers with the aid of very big aerials.

According to the planned programme the photographic apparatus was switched on aboard Lunik III at 6 hr.-30 min. (Moscow Time) on October 7 (the satellite was launched on October 4, 1959). The taking of the pictures was timed so that the satellite on its orbit should be between the moon and the sun which lit about 70% of the unseen side of the moon. At the time the satellite was at a distance of

60,000—70,000 km. from the moon, and about 470,000 km. away from the earth. The photographing continued for about 40 minutes. The special orientation system which included optical and gyroscopic pick-ups, logistic electronic devices and control machines, insured the orientation of the satellite with regard to the sun and the moon necessary for photographing the invisible side.

The first published photograph of the moon's circular disc shows about three-fourths of the hidden side and about one-fourth of the seen side with features already known to man. The latter enables one to piece together the hitherto unseen lunar objects and those already known, and thereby to determine their selenographic co-ordinates. It is now possible to determine the true form of several known lunar formations, specifically the Southern Sea, whose

considerable portion is located on the other side of the moon. The photographs show that mountainous areas occupy most of the moon's reverse side and there are very few seas of the kind seen on the side facing the earth. There is a mountain range stretching over 2,000 km. to the south-southeast of the Humboldt Sea. It crosses the equator and continues into the southern hemisphere. Beyond the mountain range is an extensive mainland with a heightened reflective capacity. There is a crater sea about 300 km. in diameter between 20 and 30° latitude North and 140 and 160° longitude West. This has been named the "Sea of Moscow". The bay in the southern part of this sea has been called the "Bay of Astronauts". Other craters clearly discernible in the photograph have been named "Tsiolkovsky", "Lomonosov" and "Joliot-Curie".

SOLAR ORIGIN OF THE OUTER ZONE OF TRAPPED RADIATION

EXPERIMENTS with three space rockets, viz., Pioneer III, the first Russian cosmic rocket and Pioneer IV, which were launched on different dates inside of three months, have provided confirmatory evidence for the solar origin of (at least) the outer zone of the trapped radiation surrounding the earth (see *Curr. Sci.*, 1959, 28, 229). The two U.S. deep-space probes Pioneer III and Pioneer IV were launched on December 6, 1958, and March 3, 1959, respectively, while the Russian cosmic rocket was launched on January 2, 1959. The Pioneer programmes were conducted under the same space investigation project so that the scientific equipments for collection and transmission of data in the payloads of the two probes were practically identical. Hence from a comparison of the two sets of observations fairly reliable conclusions could be drawn, especially regarding temporal changes in the trapped zones (see *Nature*, 1959, 184, 219).

One striking fact that has emerged from this comparison is that the intensity of the trapped radiation in the outer zone was enormously greater on March 3, 1959, than on December 6, 1958; at the same time the region of maximum intensity had extended some 15,000 km. farther out. Thus at distances from the centre of the earth of 40,000, 45,000 and 50,000 km., the counting rates of the two respective Anton 302 Geiger tubes (with tested identical characteris-

tics) were 55, 20 and 8 with Pioneer III, as against 16,000, 2,400 and 230 respectively, with Pioneer IV. The region of maximum intensity was 20,000–25,000 km. with Pioneer III, while it was 32,000–42,000 km. with Pioneer IV. It is to be noted that the observations with the Russian cosmic rocket showed that the general character of the outer zone was much the same on January 2, 1959 as it was on December 6–7, 1958.

Geophysical observations showed that there was a magnetic storm on February 25 and that there were auroræ of strong intensity on February 25–28 and on March 1. A special study of these phenomena revealed that there were at least three sequences of geophysical events starting on February 25, March 26, and April 23 respectively, which were due to intense M-region activity in the Sun. It is very significant that the launching of Pioneer IV was preceded by days of geophysical disturbances, whereas Pioneer III and the Russian cosmic rocket were launched during quiet geophysical periods.

These facts suggest that the large temporal differences shown by the Pioneer observations are due to changes that had taken place in the outer zone following strong corpuscular emission from the Sun. Pioneer IV has thus provided direct evidence for the solar origin of the outer radiation zone.

HIGH ENERGY PHYSICS

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THE Ninth Annual International Conference on High Energy Physics was held in Kiev from 15th to 25th July 1959, under the sponsorship of the International Union of Pure and Applied Physics. This was the first time it was being held in the USSR after the decision taken two years ago to hold it in Rochester, Geneva and USSR in successive years. About 350 scientists from 30 countries including India participated. Of these about 150 were from USSR. The division of sessions followed almost the same pattern as the last year's conference at CERN.* A separate session was however allotted to nuclear interactions at super-high—cosmic ray—energies. The rapporteur system introduced in the 1958 conference was employed, but not too successfully.

The field of nucleon structure and electromagnetic interaction was reviewed by R. Hofstadter, L. I. Schiff and W. K. H. Panofsky. The general picture with regard to the charge and magnetic moment distribution of the nucleon and the limits of validity of quantum electrodynamics has not changed much during the course of the last year, although the accuracy of much of the data has improved and some new ideas have emerged. Mention must be made of an experiment that is in an advanced design stage at Stanford, and will be attempted next year. In this experiment, two electron beams, each of 500 Mev, will be stored in separate magnetic storage rings and made to collide, thus providing data on electron-electron interaction, and thereby on the validity of quantum electrodynamics, at much shorter distances ($\approx 0.04 \times 10^{-13}$ cm.) than has been possible so far.

In the sessions on pions and nucleons, one saw a significant improvement in the phase-shift analysis of $\pi-N$ scattering up to ~ 400 Mev. D-wave interaction in the $T=3/2$ state has been established by polarization experiments at ~ 310 Mev. The problem of Puppi-Stanghellini does not exist any more, in the sense that there is no more any indication of a serious discrepancy between the $\pi-N$ scattering data and dispersion relations. The discrepancies at very low energies have disappeared too, mainly as a result of the remarks of Cini *et al.* regarding the uncertainties in the extra-

polarization of the experimental data to zero energy. There is therefore no longer any need for Baldin's π_0^0 meson, which was invented just to explain these discrepancies. There were, however, several attempts to detect this π_0^0 meson, as also the heavier ρ^0 meson of Schwinger, which were reported at this conference. All of them were unsuccessful, so that one can definitely say that π_0^0 does not exist; but more experiments are needed to rule out ρ^0 , and these are continuing.

Pontecorvo reported several attempts to improve the accuracy of our knowledge regarding the validity of the charge independence hypothesis in phenomena involving non-strange particles. However, even now it seems rather difficult to make a quantitative statement on the degree of possible deviations from charge independence. It is just that the experimental data are not yet sufficiently accurate for this purpose, and one can only say that the various predicted equalities or inequalities connecting different cross-sections are satisfied to within 10-15%. Therefore, the only violation of charge independence which has been experimentally proved is the well-known "trivial" experimental fact that the different members of a charge multiplet do have slightly different masses. There is no contradiction with charge independence in phenomena involving the strange particles too. There is also no evidence for the violation of parity in strong interactions.

The prediction made at the 1958 conference by R. R. Wilson on the basis of photo-production experiments, that there must be two more resonances in the $\pi-P$ total cross-section in addition to the well-known one at ~ 190 Mev, has been confirmed experimentally. Both these resonances are in the $T = \frac{1}{2}$ state, since they occur for π^-P but not for π^+P . The first of these, at ~ 650 Mev, is probably characterized by $J=3/2^-$. The second one at ~ 950 Mev is less understood, though there are arguments in favour of its being in the $J=5/2^-$ state.

There has been a considerable revival of interest in the pion-pion interaction. On the one hand, it has become apparent that further theoretical progress in the understanding of the pion-nucleon interaction requires a prior understanding of the $\pi-\pi$ interaction. On the other, there are several experimental indications that

* See *Current Science*, 1958, 27, 294, for a review of the 1958 Conference, held at CERN, Geneva.

$\pi - \pi$ interaction has to be taken into account in the analysis of $\pi - N$ data above the 3-3 resonance. Thus the cross-sections for $\pi + N \rightarrow \pi + \pi + N$ are "large" in the energy region near threshold in the sense that they considerably exceed the values calculated from the static model of Chew and Low. Rodberg has analyzed some of these data and gets a good fit on the assumption that the "large" cross-section for pion production by pions near threshold is mainly due to $\pi - \pi$ interaction, i.e., to the interaction of the incident π with a "cloud" pion, the contribution of such an interaction being estimated by the impulse approximation. Whether these "large" cross-sections are definitely due to $\pi - \pi$ interaction or not, is too early to say. But it is clear that investigations in this threshold region are very promising from the point of view of getting information on the $\pi - \pi$ interaction. At very high energies ($\gtrsim 1$ Bev) too, one seems to need $\pi - \pi$ interaction for the analysis of the data, as discussed by Veksler. Previous theoretical work on this problem was greatly handicapped by the lack of a framework in which to make plausible approximations. The double dispersion relations of Mandelstam have, however, now provided this framework, and Chew and Mandelstam have been studying the $\pi - \pi$ interaction by this approach. If the $\pi - \pi$ interaction is so important as it now seems to be, one wonders if the previous success of the fixed source theory of Chew and Low, which did not take this interaction into account, was not fortuitous.

There has been considerable interest in recent years in the dispersion relations approach to the solution of the difficulties facing quantum field theories of strongly interacting systems. The dispersion relations are relations between the real parts and the imaginary parts of scattering amplitudes, and are obtained from the analytical properties of the scattering amplitudes, when the energy and angle variables are extended into the complex plane. Some important advances have been made recently in this field, starting with the so-called double dispersion relations conjectured last year by Mandelstam. These were reported by Chew.

Coming to the strange particles, and the experimental techniques used in their study, one may say that bubble chambers have now come into their own. There were data from a variety of bubble chambers—liquid hydrogen, propane, xenon, freon, methyl iodide loaded propane, etc. One also saw that a higher degree of automatization is going into

the scanning and analysis of bubble chamber pictures. Alvarez referred to the computer device used at Berkeley, which does a complete least squares fitting of kinematic constraints to complicated interactions of strange particles in hydrogen and deuterium, in about four seconds per event. The 72" hydrogen bubble chamber at Berkeley has now gone into operation, and is being exposed to a purified anti-proton beam. Berkeley has two clear instances

of $\Lambda^0 - \bar{\Lambda}^0$ pair production *via* $p + \bar{p} \rightarrow \Lambda^0 + \bar{\Lambda}^0$. The xenon bubble chamber of the Michigan group has also started working and has given valuable information on the neutral decay modes of Λ^0 and K_1^0 ($\Lambda^0 \rightarrow n + \pi^0$; $K_1^0 \rightarrow \pi^0 + \pi^0$). One thus knows that all the Λ^0 which do not decay *via* the charged mode ($\Lambda^0 \rightarrow p + \pi^-$) do indeed decay *via* the neutral mode; there are also a large number of $K_1^0 \rightarrow \pi^0 + \pi^0$ events, which have diminished, if not removed, the discrepancy between the experimental branching ratio of K_1^0 and its theoretical prediction on the basis of the $|\Delta T| = \frac{1}{2}$ selection rule. It thus appears that all the present experimental data on strange particle decays are consistent with the $|\Delta T| = \frac{1}{2}$ rule, and one of the important theoretical questions is to understand how this empirical selection rule can be reconciled with the $T = \frac{1}{2}$ current rule of Marshak, Okubo and Sudarshan.

It is now known from the Berkeley hydrogen bubble chamber experiments that the neutral K-particles are heavier than their charged counterparts, the mass-difference being about 4 Mev. This is opposite to the situation existing with the other known bosons, the π^0 being lighter than π^\pm . The charge exchange of the K^- is therefore a threshold reaction, and this fact will have to be taken into account in an understanding of low energy K^- interactions. This has been discussed by Jackson and Wyld.

There is no unambiguous evidence about the parity of $(KN\Lambda)$ yet. One had hoped to get this information out of the dispersion relations for K^\pm nucleon scattering, but the experimental data are as yet inadequate for the purpose. There is now more or less conclusive evidence from small angle scattering of K-mesons with hydrogen that the K^+P interaction is repulsive, and the K^-P interaction attractive. The phenomenological analysis of K^-P interactions reported by Dalitz at the 1958 conference has been carried further. Global symmetry has been laid to rest (but 'Symmetries like old warriors do not die easily'—Salam), since there is no consistent way

known of using global symmetry. There was not much talk about the $KK\pi$ coupling of Pais, nor any experimental evidence for it.

An interesting communication in the session on New Theoretical Ideas was from Drell who discussed the possibility of quantizing boson fields with anti-commutators and fermion fields with commutators. This is possible if one gives up microscopic causality, and Drell suggested that the strange particles may have this wrong connection between spin and statistics, and this could be determined experimentally.

The last of the definitely expected particles in the Gell-Mann Nishijima scheme has now been observed in the hydrogen bubble chamber at Berkeley. This is the Ξ^0 particle; it was produced in the reaction $K^- + p \xrightarrow{1.15 \text{ Bev.}} \Xi^0 + K^0$ and decayed via $\Xi^0 \rightarrow \Lambda^0 + \pi^0$. Its mass is 1326 ± 20 Mev in good agreement with the accepted value $M_{\Xi^-} = 1321 \pm 3.5$ Mev.

Day, Sucher and Snow have argued that almost all ($\geq 99\%$) captures at rest of K^- in hydrogen and deuterium takes place from the S-state. This has some important consequences: (i) the isotropic angular distribution of the decays of Σ^\pm produced from (K^-P) captures at rest shows, according to an old argument of Treiman, that Σ^\pm have spin $\frac{1}{2}$; (ii) the ($\Lambda^0 2\pi$) production data from (K^-P) atoms can now be used to determine the parity of K^- relative to ($\Lambda^0 P$). (Okun and Pomeranchuk); (iii) The Adair analysis, together with the known spins of Σ^\pm , can now be used to re-establish with high probability that the spin of K^0 and K^+ is zero.

The last remaining difficulty in the way of a Universal Fermi Interaction of the V-A type for non-strange particles was removed by the discovery of the $\pi \rightarrow e$ decay by the CERN group and the very good agreement of the experimental branching ratio $\pi \rightarrow e/\pi \rightarrow \mu$, as measured by various groups, with the theoretical value. The weak decays of the ordinary particles thus seem to be fairly well understood now. There, however, remain several problems with regard to the decays of strange particles, both leptonic and non-leptonic. These were discussed by Marshak. One of the problems relating to leptonic decays is to understand the very low frequency with which they occur. They are at least ten times slower than what one expects

on the basis of Universal Fermi Interaction (unrenormalized). It may be mentioned that two leptonic decays of Λ^0 have now been identified, but none so far of Σ^\pm .

Alikhanov reported on results coming from several laboratories on uncommon decay modes of π^- and μ^- mesons. These include

$\mu^+ \rightarrow e^+ + \nu + \bar{\nu} + \gamma$, $\mu^+ \rightarrow e^+ + e^- + e^+ + \nu + \bar{\nu}$, $\pi \rightarrow \mu + \nu + \gamma$, which have been observed to occur, roughly with the theoretically expected rates, and $\mu \rightarrow e + \gamma$, $\mu^\pm \rightarrow e^\pm + e^- + e^\pm$, which have not been observed so far. The absence of the last decay mode is significant from the point of view of the Feynman-Gell-Mann-Marshak-Sudarshan theory of Universal Fermi Interaction, where the weak interactions are supposed to be of the form $J_\mu^* J_\mu$ with only terms having $|\Delta Q| = 1$ allowed to appear in J_μ .

There is further experimental information on the parity of π^0 , from a study of the angular correlations between the planes of the two Dalitz pairs in the decay of the π^0 via $\pi^0 \rightarrow e^+ + e^- + e^+ + e^-$. About 150 bubble chamber events of this type have been obtained by Steinberger's group at Columbia from the decay of π^0 s produced in the reaction $\pi^- + p \rightarrow \pi^0 + n$, and some of these have been analysed in detail. The indications from these are in favour of the expected pseudoscalarity of π^0 .

There was some uncertainty at the time of the 1958 conference regarding the helicity of the proton from Λ^0 decay. This has now been removed by the confirmation of the MIT result that it is negative.

The Milan group presented an event which seems more or less definitely to be a ($\Sigma^- n$) hyperfragment. This is very interesting, if confirmed, since it would indicate that the interaction of Σ^- with nucleons is sufficiently strong to give rise to a bound state. One might mention that though the Λ^0 -nucleon interaction is strong enough to give a variety of hyperfragments, no instance of a hyperdeuteron (bound state of Λ^0 and P) has been observed so far. The only other two-particle hyperfragment which could possibly exist is a ($\Sigma^+ p$) system, and this has not yet been definitely observed.

The next International High Energy Conference will be held in Rochester in 1960.

NOBEL PRIZES FOR PHYSICS AND CHEMISTRY

THE Nobel Prize for Physics for 1959 has been awarded to Dr. Emilio Segré and Dr. Owen Chamberlain of the University of California for their discovery of the antiproton. The antiproton is one of the anti-particles whose existence had been predicted as early as 1928 when Dirac developed the relativistic theory of the electron.

The extension of Dirac's theory to the proton requires the existence of an antiproton which bears to the proton the same relationship as the positron does to the electron. Thus the antiproton would be identical with the proton in mass and spin, but would have a charge $-e$ and magnetic moment equal but opposite to that of the proton. It would be expected to be generated in pairs with ordinary nucleons and to undergo annihilation in interaction with them. These predictions about the existence and properties of the antiproton started the long search for its experimental discovery.

There have been several "unusual events" recorded in cosmic ray investigations which might be explained on the basis of the annihilation of heavy particles, as for example an antiproton-proton annihilation, but at the time of the discovery of the antiproton in 1955 by Segré and Chamberlain, no sure conclusions could be drawn from them.

Production of antiproton is a high energy interaction and calculations show that the minimum kinetic energy required for the formation of an antiproton in a nucleon-nucleon collision is 5.6 Bev, although this threshold energy may be less if the target nucleon is in a nucleus and has some momentum.

The experimental demonstration of the existence of antiprotons was made possible by the construction of the high energy Bevatron accelerator at Berkeley, California. The Experiment of Segré and Chamberlain consisted in allowing a proton beam of energy 6.2 Bev produced in the Bevatron to bombard a copper target, and examining the particles produced by this bombardment for the presence of antiprotons. By means of a momentum selector device consisting of a system of deflecting and focussing magnets, negative particles of momentum 1.19 Bev/c. were sorted out from among those scattered from the target. This equimomentum beam, however, consisted overwhelmingly of π^- mesons (nearly 50,000 for every antiproton present), and one of the main difficulties of the experiment was the sieving out of the very few antiprotons from this huge pion background. This was effected by the use of a very discriminating system of counters. One such was a

Cerenkov counter of special design which responded only to particles in a narrow velocity range $0.75 < \beta < 0.78$. The simultaneous measurement of the momentum and velocity of the particles enabled their mass to be determined uniquely and thus led to the identification of the antiproton. Subsequent experiments led to the verification of all its predictable properties. Thus its charge $-e$ is established with certainty, its mass, which is 1,840 times the mass of the electron, is known to an accuracy of about 1%. Its mean life is about 10^{-8} seconds which is "almost an eternity" compared with the characteristic time (of the order of 10^{-23} sec.) expected for decay processes associated directly with strong reactions.

The proof of the existence of antiproton has confirmed the symmetry between particle and antiparticle which comes out as a direct consequence of Dirac's theory. It is now believed that all elementary particles have their counterpart—the antiparticles, and together they are about 30 in number.

Dr. Segré was born in Italy in 1905. Dr. Chamberlain was born in San Francisco in 1920.

The Nobel Prize for Chemistry has been awarded to Professor Jeroslav Heyrovsky who invented the Polarograph, an apparatus for the atomic electroanalysis of substances.

Professor Heyrovsky is famous as the founder of the polarographic method in physical chemistry. Even from the beginning of his researches in electrochemistry, nearly 40 years ago, Heyrovsky recognized the potentiality of the dropping mercury electrode in the study of electrolytic processes and he developed the technique to such a degree of discriminating accuracy that polarography has now become a new field of science.

The method consists essentially in the study of the current-voltage curves obtained in an electrolytic cell, one of the electrodes of which is the dropping mercury electrode. In the polarograph devised by Heyrovsky automatic recording of the current-voltage curve is obtained. In the presence of substances in the solution that can be determined by the polarographic method a rise in the value of the current will be recorded as a "wave" in the polarographic curve. The potential at which the "wave" is formed identifies the substance and the height of the wave determines its concentration in the solution.

Heyrovsky's "Polaroskop" is a later development of the apparatus and in this the oscillographic method is used in polarographic

studies. The method helps the investigation of electrode reactions proceeding on a single drop of mercury. In this apparatus the presence of particular substances in the electrolytic solution is signalled by "cuts" appearing in the oscillograph curves. The position of the cut identifies the substance, while the depth of the cut gives the amount present. In the latest development of the apparatus, the "Impulse Polarograph", the curves are obtained by the application of voltage impulses which method reduces the time of study to a matter of a few seconds.

STRUCTURE OF VITAMIN B₁₂

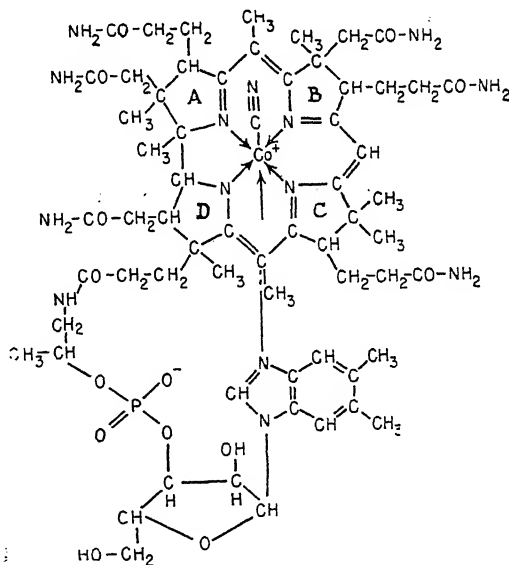
THE solving of the structure of vitamin B₁₂ by Dorothy Crowfoot Hodgkin, John White and their collaborators is one of the most striking results in the use of X-ray crystallography for the determination of structure of molecules. When this work began in 1948 there was practically no information regarding the chemical nature of the vitamin but during the next eight years chemical structures of many groups within the molecule could be determined. A group consisting of a benzimidazole ribose phosphate, a propanolamine residue and various amide groups were discovered. There was also a cyanide group, and the presence of a large porphyrin-like fragment containing cobalt was suspected. There was no direct chemical evidence as to how all these groups might be linked together. The presence of the cobalt containing fragment and the possibility of a nearly planar porphyrin group (the crystals being strongly pleochroic) stimulated the X-ray work. If a structure is not too complex the presence of a single atom like cobalt favourably situated may sometimes lead to a complete structure determination.

But vitamin B₁₂ is far too complex. The dimensions of the air-dried crystal are about $24 \times 21 \times 21$ Å (space group $P 2_1 2_1 2_1$ with 4 molecules in the unit cell). With the phases based on cobalt contribution the density maps were too blurred and confused. In addition to the wet and dried vitamin the selenocyanate derivative B₁₂SeCN with a secondary heavy atom was also studied. But the compound that was really responsible for the solution of the structure was the one prepared by Todd and his co-workers. This was the hexacarboxylic acid obtained by degradation (alkaline hydrolysis) which contained the porphyrin nucleus and its side chains. This crystalline compound was much less complex than the full vitamin ($C_{46}H_{58}O_{23}N_6CoCl$ instead of $C_{63}H_{88}O_{14}N_{14}$

Polarography, besides its many uses in theoretical chemistry, has found wide applications in industry, biology and medicine.

Professor Heyrovsky was born in 1890 in Prague. He is the Director of the Polarographic Institute at Prague. Among the honours Professor Heyrovsky received are the State Prize of the 1st degree (1951), the Order of the Republic (1955), Honorary Fellow of the Indian Academy of Sciences (1958), First Silver Medal of the London Polarographic Society (1959).

PCO—but these formulæ were not established till later). The course of X-ray analysis consisted in first fixing the cobalt atom from Patterson projections and finding the positions of the remaining atoms by a series of calculated approximations to the three-dimensional electron density distribution. These authors write "The solution was so unexpected that it is still not so easy for us to assess accurately the factors that made it possible. It is clear that X-ray analysis, fully supported by rapid techniques of calculation, is a more powerful tool for the direct chemical study of complex asymmetric structures than we had previously thought". The structure of the nucleus itself was cleared



up. It consists of a central cobalt atom in approximately octahedral co-ordination attached to one cyanide group, one chlorine atom and four nitrogen atoms of the corrin nucleus.

Leading out from these four, the positions of other atoms in the nucleus could be traced in four five-membered rings A B C D. There was one unusual and unexpected feature which was at first difficult to accept. This was the direct linking of two of the 5-membered rings (A and D) without an intermediate bridging atom, with a methyl group attached directly to one of the tertiary carbon atoms.

Most of the tremendous numerical calculations required during the evaluation of the triple Fourier series of several thousand terms at tens of thousands of points were done on the electronic computer SWAC by Trueblood at the University of California.

The figure shows the chemical formula. Using the Bijvoet method these workers have also established the absolute configuration of this molecule.

PLANT DISEASE IN RELATION TO NUTRITION

1. Effect of Nitrogen, Potassium and Phosphorus on the Leaf Blight of Hollyhock

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THE host nutrition has been considered an important factor in modifying the host response to parasitic infection. The level of nutrition and the nature of nutritive elements available to the plant generally influence the development of its various organs which consequently determines in a large measure the degree of its resistance or susceptibility to pathogens, its histological and morphological structure or properties. The disease disposition by the nutrition, however, varies according to the pathogen and the host. Studies with macro-nutrients have been considerable from this view-point. It is the general opinion that nitrogen increases the susceptibility of plant to infection while potassium and phosphorus tend to decrease it. A series of investigations have been undertaken to study the effect of macro- and micro-nutrients on some of the common diseases of the crop plants and the ornamentals. This paper presents the results of investigations on the influence of nitrogen, potassium, phosphorus and the Knop's solution on the leaf blight of hollyhock (*Althaea rosea* Cav.), which

is caused by *Alternaria tenuis* Nees. The disease is also being recorded for the first time.

The symptomatology reveals that the older leaves at the base are heavily affected and the young ones escape infection till late in the season. There is usually no infection on the stem but the flowers at the axil of the more heavily infected leaves may be attacked. The disease initiates as small, isolated pale-brown spots at the tip and margin of the leaves, which develop irregularly as circular or narrow well-defined areas; some of them coalescing and extending centrally downwards reaching up to the petiole. Later the infected regions exhibit pronounced curls, cracks and folds which dry up and become brittle, often producing irregular holes in the leaf lamina due to the disorganisation of the tissue (Fig. 1).

The pathogenicity tests have shown that the fungus gains entry through the stomata or the weak and injured regions on the lower surface of the leaves and not through the upper surface, even if injured.

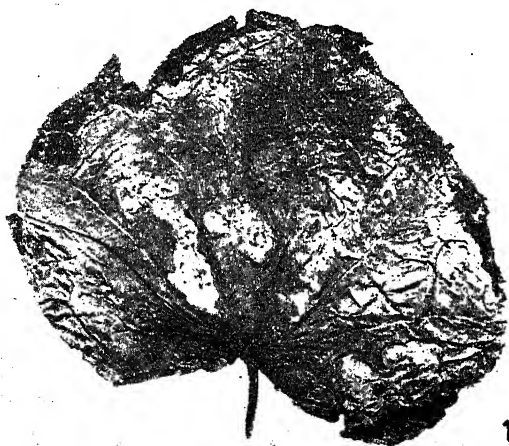


FIG. 1. A naturally infected leaf of hollyhock.

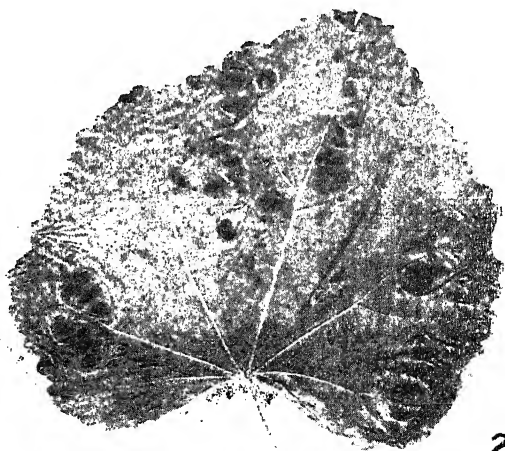


FIG. 2. An experimentally infected leaf of the same.

For the study of the influence of the macro-nutrients on the host susceptibility, hollyhock plants were raised in pots filled with ordinary unmanured garden soil, which was dressed with definite quantity of sodium nitrate for nitrogen (0.36% and 0.18%), disodium hydrogen phosphate for phosphorus (0.18% and 0.09%) and potassium sulphate for potassium (0.36% and 0.18%) prior to seed sowing. Nearly uniform conditions of growth were maintained for the plants except the varying concentration of the nutrient in the soil. The nitrogen-fed plants had leaves with broad and expanded lamina, were fast growing and more than double the size of those growing in the phosphorus-fed soils, which were the shortest and with comparatively small leaves. The plants growing in the 6" pots measured as: nitrogen 8-12", potassium 5½-7½" and phosphorus 3-5½" in height.

To study the influence of the Knop's solution on the susceptibility of hollyhock plants to

chlorosis, spotting and the blight. The general symptoms as developed in all these experimentally inoculated plants resembled those occurring in nature (Fig. 2) and the fungus employed for inoculation was reisolated from these. The results have been presented in Figs. 3 and 4.

It is evident from Fig. 3 that the plants grown in nitrogen-dressed soil show the incidence of the disease in nearly half the time than those in the potassium or phosphorus. The higher the percentage of nitrogen in the soil, the more the plants are susceptible to blight while in the case of phosphorus-fed plants, the higher concentration seems to make them more resistant. The status of potassium in this regard is intermediate, although the data indicate that the lower strength favours the disease appearance.

The increase in the solute concentration of Knop's does increase the susceptibility of hollyhock plants up to the 2 normal stage, in which the plants exhibit a general and complete

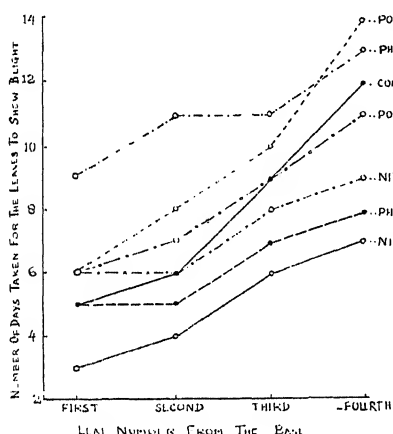


FIG. 3. Showing the pathogenicity of *A. tenuis* on hollyhock plants raised in ordinary soil dressed with the macro-nutrients.

A. tenuis, seeds were sown in glass jars filled with water washed sand. After forty-eight hours of the seed sowing the cultures were periodically supplied with Knop's solution of concentrations of 0.5 N, N, 2 N, 4 N, 8 N and 16 N. The plants supplied with 16 N solution did not survive beyond the cotyledonary stage, while those growing in the normal and 2 normal strengths were more succulent and green than the others.

The six to eight-leaved plants, in both these sets of experiment, were inoculated by the usual 'spore suspension spray' method on the lower surface of the leaves. The development of the infection was recorded in three stages, viz., the

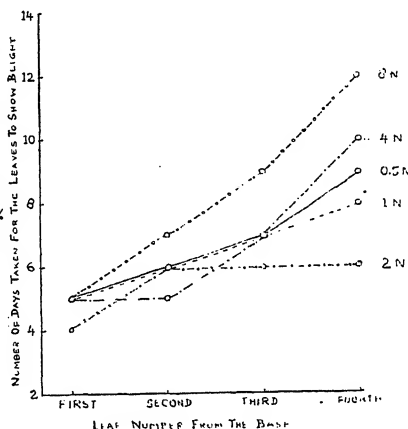


FIG. 4. Showing the pathogenicity of *A. tenuis* on hollyhock plants raised in ordinary washed sand dressed with various concentrations of Knop's solution.

blighting of all the leaves within 4-6 days after the inoculation (Fig. 4). This corresponds very much to the results obtained for the plants dressed with nitrogen. In higher strengths, however, the infection is not as severe and general. Leaves of plants growing in 4 normal had average number of spots mainly developed centrally while in the case of 8 normal plants the number of spots was fewer but comparatively big and marginal. In both these cases the apical leaves remained unaffected even after twelve days of the inoculation.

The author is thankful to Prof. S. N. Das-Gupta for his interest and valuable suggestions during the course of study.

LETTERS TO THE EDITOR

EQUATIONS OF STEPHENSON AND
SPHERICAL SYMMETRY

In a recent paper Stephenson¹ has suggested some field equations obtained by the use of quadratic Lagrangians formed from the Riemannian Curvature tensor and its contraction in a four-dimensional Riemannian Space. In the variational principle adopted for the purpose the metric tensor and the affine connection components are treated as independent variables. After the variation is performed the affine symbols are specialized as the usual Christoffel connections.

The field equations obtained by the use of the invariant $R_{ik}R^{ik}$, in the variational principle specified above, are as follows:—

$$R^{is}R_{ks} - \frac{1}{4}\delta_k^i R_{sm}R^{sm} = 0 \quad (1)$$

$$R^{ik}; s = 0 \quad (2)$$

These equations differ from Einstein's equations for empty Space-time in their mathematical form and complexity. These are second order second degree partial differential equations in g_{ik} whereas Einstein's equations $R_{ik} = 0$ are of the second order first degree. The left-hand side of (1) becomes divergence-free by virtue of the relation (2). It is easy to see that any solution of $R_{ik} = 0$ will also be a solution² of the system of equations (1). The main object of this note is to show that Schwarzschild's exterior solution is the only spherically symmetric solution of the set of equations (1) and (2).

For this we start with a spherically symmetric line-element in the form

$$ds^2 = -e^\lambda dr^2 - r^2(d\theta^2 + \sin^2\theta d\phi^2) + e^\nu dt^2 \quad (3)$$

where λ and ν are functions of r and t . Since the only non-vanishing components of R_{ik} in case of (3) are R_{11} , R_{22} , R_{33} , R_{44} and $R_{14} = R_{41}$ the system of equations (1) and (2) ultimately reduce to a system of ten differential equations in λ and ν . Only five out of these ten are found sufficient to determine λ and ν in the form

$$e^\lambda = 1 + \frac{2cr^2}{3} + \frac{\phi(t)}{r} \quad (4)$$

$$\nu' = \lambda' + 2cre^\lambda + \frac{2e^\lambda}{r} - \frac{2}{r} \quad (5)$$

where c is the arbitrary constant, $\phi(t)$ is an arbitrary function and an overhead dash indicates a partial differentiation with respect to r .

The consistency of the rest of the five equations, with the above solutions for λ and ν , demands that c should be equal to zero and ϕ be a constant. When these requirements are fulfilled, the relations (4) and (5) reduce to the well-known Schwarzschild exterior solution. It is, therefore, proved that Stephenson's equations do not describe any new gravitational situation in so far as spherical symmetry is concerned.

The author wishes to express his indebtedness to Prof. V. V. Narlikar for suggesting the problem.

SATYA NARAYAN PANDEY.

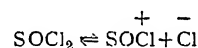
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ZIRCONIUM TETRACHLORIDE
COMPLEXES IN THIONYL CHLORIDE

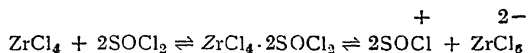
ZIRCONIUM TETRACHLORIDE presumably possesses d^3s configuration as the excitation of one electron from the s orbital to the d orbital consumes 36 K cals while the transfer of one s electron to the p orbital absorbs 42 K cals.¹ Naturally the d^3s arrangement of electrons in zirconium tetrachloride provides chances for the molecules to take up two more electrons so as to acquire the more stable $d^2s^2p^3$ configuration. This view is substantiated by the fact that zirconium tetrachloride which absorbs moisture quite readily, after complex formation provides a saturated and quite stable molecule.

The properties of zirconium tetrachloride as a solvoacid in acetyl chloride,^{2,3} benzoyl chloride^{4,5} and thiophosphoryl chloride⁶ have already been investigated. Zirconium tetrachloride is fairly soluble (1-2%) in thionyl chloride and its solutions are much more conducting than the pure solvent. The ionization of thionyl chloride has already been postulated.⁷⁻¹⁰

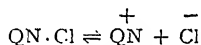


The mode of ionization of zirconium tetra-

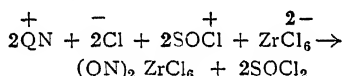
chloride as a solvoacid in thionyl chloride may be postulated as under :—



Quaternary ammonium chlorides which are analogues of bases in acid chloride solvents^{2,4} are appreciably soluble in thionyl chloride and enhance the conductivity of the latter to a considerable extent. The mode of ionization is expressed as under :



The solutions of zirconium tetrachloride and quaternary ammonium chlorides in thionyl chloride react to form precipitates which are salt-like in appearance and are unaffected by moisture. The formation of these complexes on the basis of ionization of the solvent, solvoacid and ansolvobases may be expressed as follows :—



The complexes of triethylbenzylammonium chloride and diethylphenylbenzylammonium chloride with zirconium tetrachloride are very soluble in thionyl chloride and do not separate even when most of the solvent is removed. These are precipitated by the addition of dry ethyl acetate.

There is an interesting case with the complexes of trimethylbenzylammonium chloride and triethylbenzylammonium chloride. The complex of the latter is highly soluble in

thionyl chloride while that of the former is insoluble. This pair of ansolvobases which presents striking influence of substituents on the nature of the complex and its properties, has been employed in the study of complex forming property of zirconium tetrachloride by conductimetric methods.

Conductimetric titrations in thionyl chloride indicate breaks at molar ratio of acid to base of 1 : 2. In the case of trimethylbenzylammonium chloride (I) turbidity appears with the addition of a few drops of the acid solution and it goes on increasing till the lowest value of relative conductance is achieved. This point shows completion of the reaction and separation of the normal complex. Afterwards, the addition of acid solution brings about dissolution of the precipitate and as a consequence the conductance shows a marked increase. However, the precipitate does not dissolve completely at molar ratio 1 : 1 and this regular increase in conductance does not provide any evidence as to the existence of the acid complex. In the case of triethylbenzylammonium chloride, (II) the solution remains clear throughout the titration and the decrease in conductance with the addition of the acid solution may be explained as due to the removal of more mobile chloride ions with the formation of solvent molecules. The fall in the value of conductance may also be attributed partially to the low conductivity of the complex formed in the solution.

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June 29, 1959.

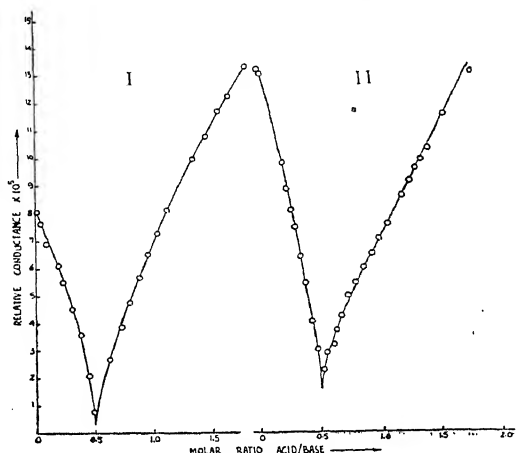


FIG. 1. Conductimetric titrations in thionyl chloride.

I. ZrCl_4 against trimethylbenzylammonium chloride.

II. ZrCl_4 against triethylbenzylammonium chloride.

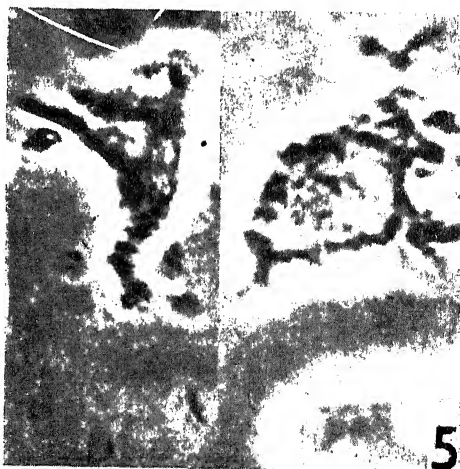
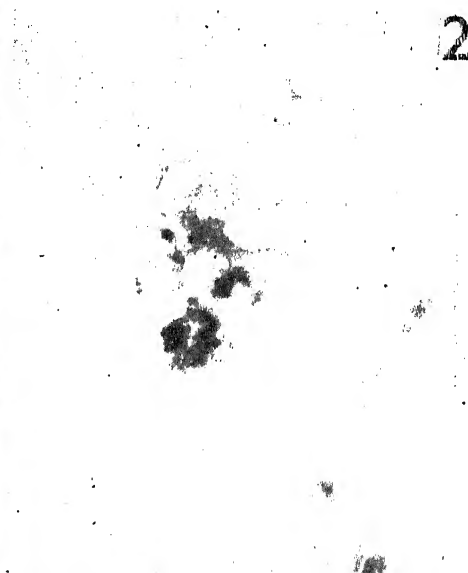
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ISOLATION AND IDENTIFICATION OF MELANOCYTES IN THE NON- PIGMENTED SKIN OF GUINEA-PIG AND VITILIGINOUS HUMAN SKIN

THE pure epidermis preparation technique of Medawar¹ was utilized by Shukla, Karkun and Mukerji² to isolate the pigmentogenic melanocytes of the black skin of guinea-pig and normally pigmented skin of human beings. The morphology of these cells was then studied^{3,4} under bright field microscope after

had started forming melanin, however, showed dopa positive normal melanocytes.⁶ The question therefore arose whether (a) melanocytes had been formed afresh in the repigmented skin or (b) the melanocytes were already present at the depigmented site but could not be visualised as they were dopa negative and on treatment were stimulated to become dopa positive.

To verify these hypotheses an attempt was made to have isolated cell preparations from



FIGS. 1-5

staining with L-3, 4, dihydroxyphenyl-alanine (dopa). The white skin of guinea-pig and vitiliginous human skin, on similar treatment, did not reveal any dopa positive melanocytes.⁵ Examination of treated vitiliginous skin which

the non-pigmented skin of guinea-pig and from vitiliginous human skin and examine them under the phase contrast microscope. It was observed that such preparations showed cells which were morphologically similar to the

melanocytes but did not give the dopa reaction. Figures 1 and 4 show melanocytes from the white skin of the ear of the guinea-pig and from the vitiliginous peroneal surface of the leg of human subject respectively. To compare them with the normal pigmentogenic cells, melanocytes from identical pigmented areas of guinea-pig and of human skin respectively have been shown in Figs. 2 and 3.

This observation, therefore, indicates that non-pigmented and vitiliginous skin is not devoid of melanocytes. These melanocytes, perhaps, differ from those of the pigmented skin in the loss of pigmentogenic activity and give a negative dopa reaction.

It was further observed that vitiliginous skin showed occasional aberrant varieties of melanocytes (Fig. 5). These cells had a rounded shape and their dendritic processes were short and club-shaped. This conforms to Greenburgs⁷ contention of rotundity of the amelanotic melanocytes in melanoma tissue culture.

Thanks are due to Shri R. K. Soraut for technical assistance and Shri S. Banerji for the photomicrographs.

Central Drug Res. Inst.,
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CONGENITAL DEFECTS OF THE REPRODUCTIVE ORGANS IN WATER- BUFFALOES (*BOS BUBALIS* L.) FOUND IN UTTAR PRADESH

FROM the breeder's point of view, congenital defects of the reproductive organs in domesticated animals are very important. They may reduce fertility or make the animal totally sterile. There cannot be any curative treatment but such defects can be prevented provided we know how they are brought about. With the above objective in view, a detailed study of 425 genital organs, collected from the slaughter house, Agra, was carried out in the winters of 1956 and 1957. The following defects which appear to be congenital were

found. The defects, seen in cattle,¹ have been described elsewhere.

I. OVARIAN ABNORMALITIES

(a) *Dermoid cyst*.—The ovary, from external appearance, seemed normal except that it was slightly bigger in size and slightly different in feeling. On sectioning, it was seen that there was no ovarian tissue in it. The pulpy substance contained masses of hair tufts and some black pigment deposits. The condition was present on one side only.

(b) *Hypoplasia of the ovary*.—In a few cases very small, either bean-shaped or a little longer than normal, but thin ovaries were seen. On sectioning with razor a few small Graafian follicles could be seen. However, on histological studies they appeared to be normal though diminished in size. It was considered as partial hypoplasia of the ovary. It was also seen generally on one side. In our studies we came across a case of total hypoplasia in a buffalo as has been reported^{2,3} in cattle.

II. FALLOPIAN TUBE

(a) *Non-patency of the tube*.—In the material we found 9 cases of non-patency of the fallopian tube. It was present on one side only or on both sides. In some the contents of the tube were definitely pus-like but there were 3 cases where the non-patency of the tube was considered as a congenital defect. The oviduct was not a tube but a mesh of small cysts. The fluid present in the lumen of the tube when cultured for bacteriological growth did not reveal anything. Surprisingly in one case where this condition was present, another anatomical abnormality—a double cervix was also detected.

There are, however, many affections of the fallopian tubes giving more or less a similar picture but in these cases the inside fluid is inflammatory and is caused by bacterial infection.

(b) *Absence of fimbriæ*.—A case was seen where the anterior part of the fallopian tube had no fimbriæ. It ended in a blind tube and was attached to the broad ligament of the uterus. There was a complete absence of the fimbriated end and this condition was present on both sides.

III. UTERUS

(a) *Non-development of the horns*.—At puberty, under the influence of the anterior pituitary, the sexual organs develop rapidly and attain the normal adult size. In one case the uterine horns were found to be thin, tube-like structures in the adult stage; evidently

the development from the infantile to the adult size had not taken place.

(b) *Convolutions in the horns*.—Normally the uterine horns in the buffaloes are smooth and they do not give any appearance of notches or rings. In a few cases (about 3-5%) this condition was met with. On opening the horns, the inside lumen of the horn gave a different appearance. In a pregnancy of a few weeks, the rings would become obliterated and the convolutions would disappear owing to the foetal development in the horn. It is difficult to say if this condition can be termed pathological. It may be an intermediary stage in the evolution of the species when it may be carrying several young ones in each pregnancy.

(c) *Double cervix*.—In one case the uterus had two cervical openings in the vagina. One was in the middle of the portio and the other was on one side, on the superior border (Fig. 1).



FIG. 1. Genital organs of a water-buffalo showing double cervix (a preserved specimen, rods have been used to make the openings clear in the photograph).

Both had patent openings in which a glass catheter could be passed. The second opening on one side was, however, having less prominent cervical folds. This condition may complicate the delivery of the foetus as one of its parts may get engaged in one opening or in the expulsion of the placenta. Recently Shalash (1958) found the incidence of double cervix as 0.17% in Egyptian buffaloes. This condition is rarely met with in our country.

(d) *Melanin deposits in the mucous membrane of the uterus*.—The uterine mucous membrane gives a pinkish appearance. In some of the genital organs, the appearance of the mucous membrane is changed to blackish brown. It may be in the form of specks or in areas.

No abnormality in the vagina was found in this study.

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ON A NEW SPECIES OF *SPIROXYLON*, *S. INTERTRAPPEUM* FROM THE DECCAN INTERTRAPPEAN BEDS OF DISTRICT DHAR IN MADHYA PRADESH

IN the present note, a new species of *Spiroxylon*, *S. intertrappeum* is described from a new locality of the Deccan Intertrappean Series about one and half miles south of the village Sitapuri (22° 20' 11"; 75° 5' 24") in district Dhar of Madhya Pradesh. So far only two species of *Spiroxylon* are known. They are *Spiroxylon africanum* Walton (1925) from Harmsfontein in South Africa, probably of Early Tertiary age, and *S. indicum* Mehta (1952) from the Lower Permian (?) carbonaceous shales of Singrauli coalfields, district Mirzapur, Uttar Pradesh.

The present material consists of four petrified pieces of decorticated secondary wood. The bigger piece measures 40 cm. in length and 8-12 cm. in diameter. The preservation of the wood is quite satisfactory. It shows the following characters:

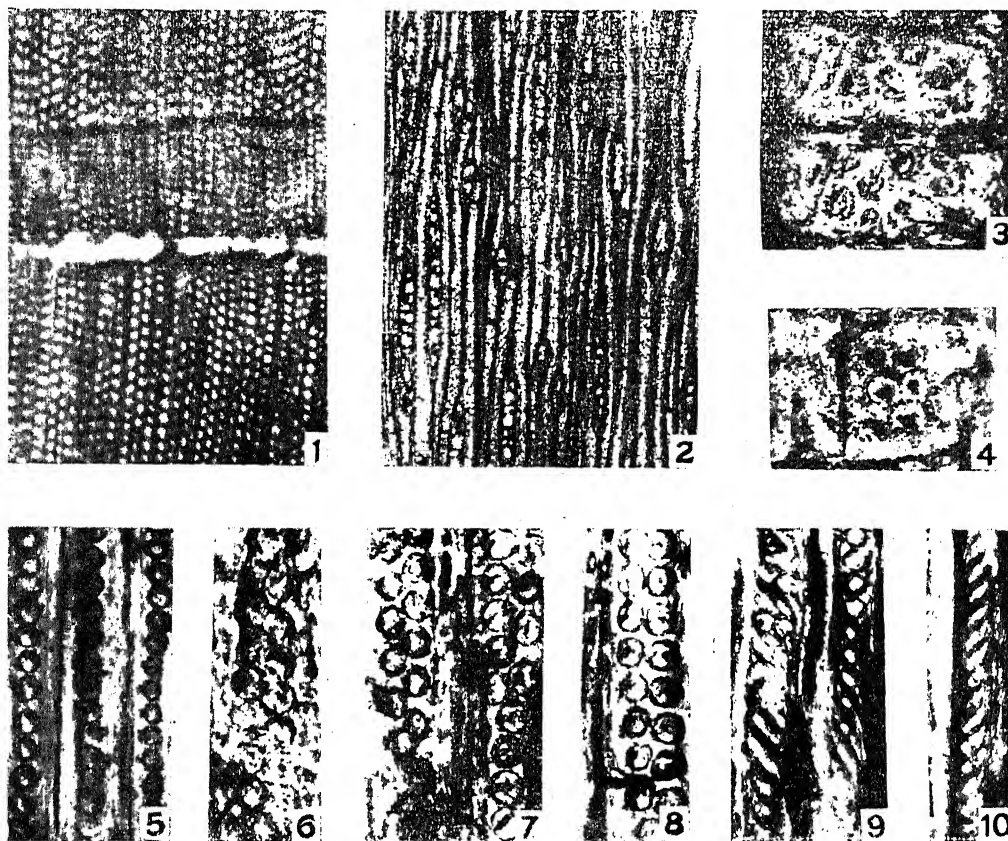
Growth rings (Fig. 1) distinct, 90-280 tracheids apart with transition from spring to autumn wood usually gradual, sometimes abrupt. Spring wood 80-250 cells wide and the tracheids wide-lumened, 44-72 μ \times 44-72 μ in size with 7-10 μ thick walls. Autumn wood 4-25 cells wide and its tracheids narrow-lumened, 28-48 μ \times 28-48 μ in size, with 7-12 μ thick walls and usually squarish to rounded in shape.

The bordered pits as well as true spiral thickenings are present both on the radial and tangential walls of the tracheids. The radial pits are mostly uniseriate (Fig. 5) and usually alternate (occasionally opposite) when in two rows (Figs. 6, 7, 8), mostly contiguous, circular or vertically compressed or hexagonal in shape

and 13-20 μ in diameter. The pit-pores are circular or obliquely lenticular and inclined towards right or left. The spiral bands are 5-11 μ thick, 2-3 seriate (Figs. 9, 10), both left and right handed, inclined at an angle of 45°-70°, and usually pass across the borders of the pits or through the space between the separate pits. The tangential pits are comparatively scarce, mostly uniseriate and separate, and

1-10, 6-11 μ in diameter, scattered or arranged in 1-3 horizontal rows, and circular or hexagonal through crowding; pore circular or obliquely lenticular. Xylem parenchyma and resin canals or cells are absent.

The presence of true spiral thickenings in the secondary tracheids in addition to the bordered pits, which are characteristically in compressed series when uniseriate and normally



FIGS. 1-10. Fig. 1. Cross-section of the wood magnified to show a growth ring, spring and autumn wood tracheids, $\times 35$. Fig. 2. T.L.S. showing medullary rays, $\times 60$. Fig. 3. R.L.S. showing cross-field pits, $\times 650$. Fig. 4. Another R.L.S. showing cross-field pits arranged in three, closely packed, horizontal rows, $\times 650$. Fig. 5. R.L.S. showing uniseriate tracheid pitting, $\times 170$. Fig. 6. R.L.S. to show biseriate, alternate pits, closely packed, $\times 240$. Fig. 7. Another R.L.S. showing biseriate, alternate pits, $\times 240$. Fig. 8. R.L.S. to show biseriate, mostly opposite pits, $\times 240$. Fig. 9. R.L.S. showing 2-3 seriate, left-handed spiral bands, $\times 170$. Fig. 10. R.L.S. showing right-handed, biseriate spiral bands, $\times 170$.

9-13 μ in diameter. Spiral bands are almost similar to those of the radial wall. Medullary rays are 1-3 seriate, usually 1-2 seriate (Fig. 2) (exceptionally triseriate), 2-30 (or up to 50) cells high; ray cells usually oblong in shape, 20-28 μ in height (average 24 μ), with horizontal and tangential walls smooth and unpitted. Indentures are absent. Ray tracheids are absent. Cross-field pits are (Figs. 3, 4)

alternate when in two series, and the absence of transverse ray tracheids, xylem parenchyma and resin canals or cells indicate the affinity of the present wood with the family Taxineae (Seward, 1919) and places it under the form genus *Spiroxylon* Walton (1925). This Intertrappean wood differs rather appreciably from the other two species of *Spiroxylon*, so far recorded. Thus *Spiroxylon africanum* differs

from *S. intertrappeum* in characters such as the size of the tracheids, absence of the tangential pits, presence of almost uniseriate, 1-18 cells high medullary rays, 1-2 seriate spiral bands and 2-8 pits in the field. In *S. intertrappeum*, there are 1-10 bordered pits in the field which are scattered or arranged in 1-3 horizontal rows. Similarly *S. indicum* can also be distinguished from the present wood in the size of the tracheids, in the absence of tangential pits, in the presence of uniseriate (?) medullary rays, 1-2 seriate spiral bands and 6-7 bordered pits in the field. However, among the living woods of the family Taxineae, the present wood shows comparatively closer affinities with *Taxus* and *Torreya* than with any other genus of Taxineae (Greguss, 1955; Florin, 1948).

The authors are grateful to Dr. R. N. Lakhanpal and Dr. M. N. Bose for many helpful suggestions.

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PECULIARITIES NOTED IN GERMINATING RICE GRAINS

GENERALLY when germination is initiated in rice, primary root breaks out of the coleorhiza and grows down. While the root is developing the coleoptile and the plumule break through the Pericarp. Pan (1936) however observed the emergence of plumule before the radicle during the germination of rice when the seeds were dried and stored for some time after soaking in 2% copper sulphate solution.

Seeds of PTB. 10, an improved strain released from the Agricultural Research Station, Pattambi, were soaked in vegetable oils such as groundnut, gingelly and neem to study whether these are capable of inducing viable mutations in rice as reported by Pal *et al.* (1958) in wheat. After soaking for 24 hours in these oils, the seeds were wiped dry, washed well with dilute solution of potassium hydroxide and water. These were then immersed in water for 24 hours and then transferred to moistened filter-papers in petri dishes. In all these plumule emerged before the radicle—the reverse

of what happens in nature—details of which are given in Table I.

TABLE I
Sequence of plumule—radicle emergence

	a	b	c
Groundnut oil	.. 95	..	5
Gingelly oil	.. 93	..	7
Neem oil	.. 98	..	2
Control	.. ..	98	2

- (a) Percentage of seeds in which plumule emerged first;
(b) Percentage of seeds showing normal germination;
(c) Percentage of seeds which did not germinate.

The primary root development was delayed in all, and in some cases there was complete inhibition of primary as well as secondary roots inasmuch as no roots were observed even after seven days. The coleoptiles appeared to be paler than normal.

In another series seeds were soaked for 24 hours in distilled water, tap-water, 0.5% hydrochloric acid and potassium hydroxide, washed well with distilled water, and allowed to germinate on moist filter-paper. In every case germination was normal except in hydrochloric acid where coleoptile emerged earlier than radicle.

Rice Section, P. C. SAHADEVAN.
Agricultural Res. Station, N. R. NAIR.
Mannuthy, Trichur,
July 29, 1959.

1. Pan, C. L., *J. Amer. Soc. Agron.*, 1936, 28, 985-89.
2. Pal, B. P., Sikka, S. M., Swaminathan, M. S., and Natarajan, A. T., *Wheat Information Service*, 1958, Kyoto, 7, 14-15.

A NEW SPECIES OF *CURVULARIA* FROM THE LEAVES OF *JASMINUM* *SAMBAC*

Jasminum sambac (Mogra) is an evergreen shrub, generally grown in houses and public gardens. It bears yellowish white flowers noted for their delicate fragrance during summer. During the month of August 1957, the plants showing dark-brown discoloured leaves were noticed in public gardens, Kota. Plating of the surface sterilised infected leaves invariably yielded the fungus *Curvularia*.

A detailed morphological study of the fungus on corn meal agar, potato dextrose agar, oat meal agar and Sabouraud's media and rice

grains was made. The conidia were found to be mostly three septate, rarely four septate. The walls of the conidia, under study, were much thicker (Fig. 1) than those in other species of



FIG. 1. *Curvularia Prasadii*. A. Conidiophore, B. Conidia.

Curvularia with three septate conidia of approximately the same size.^{1,2} It is, therefore, considered a distinct new species of *Curvularia*, (M. B. Ellis, *in litt.*) and proposed to be named as *Curvularia prasadii* in honour of Dr. N. Prasad, Plant Pathologist, Rajasthan. The detailed description of the fungus is as follows.¹

Curvularia prasadii MATHUR & MATHUR, SPEC. NOV.

Hyphae brunneae, septatae, ramosissimae, 2.4-6.4 μ . Conidiophori brunnei, simplices, recti vel curvati, septati, non ramosi, geniculati ad apicem, 80-320 \times 3.2-4.8 μ . Conidia brunnea, ut plurimum ter, raro quatter septata, inaequaliter ventricosus-fusiformia, vulgo recta, nonnumquam curvata, haud constricta ad septa, tertia cellula ex basi largior, latior atque fuscior caeteris, cellula apicalis apice levi rotundato, cellula basalis catiniformis ornata cicatrice distincta ad basin indicante punctum insertionis in conidiophorum. Conidia singula, plus minusve spirally disposita ad apicem conidiophorum numero variabili (2-10), magnit 18.0 \times 9.1 μ (12.8-25.6 \times 8.0-12.8 μ) septis fusce brunneis 1.6-2.4 μ crassis.

Typus lectus in foliis *Jasmini sambac*, in horto publico ad Kota, mense augusto anni 1957, a B. L. Mathur, et positus in Commonwealth Mycological Institute in Horto Kewensi, Anglia (I.M.I. 71475).

The culture of this species has also been isolated from Kenya and from Sahara soils by Madame Nicot (M. B. Ellis, personal communication).

We are indebted to Dr. N. Prasad, Plant Pathologist, Government of Rajasthan, for his keen interest. We are also grateful to Dr. M. B. Ellis of Commonwealth Mycological Institute for identification of species and to Dr. H. Santapau for Latin diagnosis.

Plant Pathological Section, R. L. MATHUR.
Agriculture Department, B. L. MATHUR.
Rajasthan, Kota,
February 24, 1959.

1. Rao, P. N. and Salam, M. A., *J. Indian bot. Soc.*, 1954, **34**, 268.
2. Subramanian, C. V., *Proc. Ind. Acad. Sci.*, 1953, **38**, 27.

AN AZOTOBACTER Sp. IN THE SWOLLEN ROOTS OF *CYPERUS ROTUNDUS*

DURING a study of rhizosphere organisms in common cultivated crops and weeds in agricultural fields, an organism was persistently observed with the swollen roots of the common weed Motha, *Cyperus rotundus*. The organism was isolated in the pure cultures from dilution plate technique in Ashby's mannite agar (Ashby, 1907), inoculum being a drop of liquid from the mannite solution inoculated firstly with bits of washed and surface sterilised (by immersion of uninjured roots in $HgCl_2$ and alcohol), pieces of swollen roots of the weed (Fig. 1).

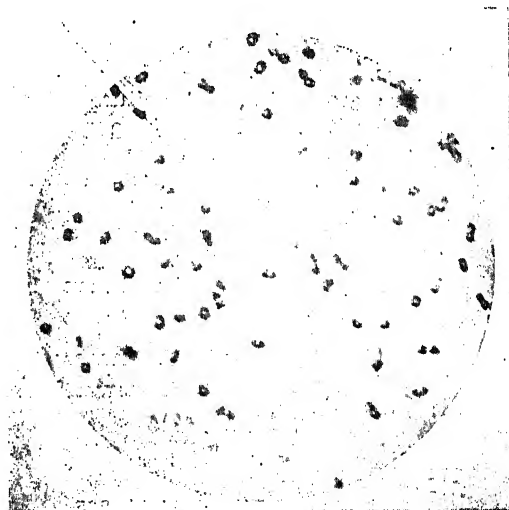


FIG. 1. The organism from the swollen roots of *C. rotundus* stained with carbol fuchsin, \times 1500.

The organism was examined morphologically and its physiological characteristics were studied. These are detailed below.

MORPHOLOGICAL CHARACTERISTICS

Capsulated rods; $3.23-4.97 \mu \times 1.16-1.79 \mu$ with capsules and $2.70-4.08 \mu \times 1.00-1.54 \mu$ without capsules; aerobic; growth between pH 4.0-11.0; highly motile at pH 4.0 and 11.0, motility decreasing towards neutrality; non-motile at pH 7.3-8.5; no endospores; gram negative; inside the swollen roots the organism is present in somewhat diminished coccoid form.

CULTURAL CHARACTERISTICS

Grows vigorously in solutions of sugars, mannite and starch, in Ashby's mannite solution, no perceptible pellicle but the liquid assumed the appearance of a thin starch paste without any pigment formation; colonies in mannite agar-translucent to opaque, ovate; growth on potato-slimy creamy white in appearance, organisms are thin rods without capsules; starch agar colonies are ovate and sometimes circular with black pigment.

BIOCHEMICAL CHARACTERISTICS

Growth in nutrient broth and nitrate broth which showed turbidity and sediment but there was no reduction of nitrate; complete decolourisation of litmus milk; no liquefaction of gelatin; no growth in 1% sodium benzoate.

The organism fixed 7.6 mg./gm. of mannite in Ashby's mannite solution (21 days), 10.2 mg./gm. of sucrose in Jensen's medium (Jensen, 1951) (14 days) and 11.8 mg. in a medium containing starch. From these characteristics it was tentatively considered as a strain of an *Azotobacter* Sp. However, it differs from the common species of *Azotobacter* in its ovate shape of pointed colonies and wide range of pH tolerance.

Maize was grown in sand culture (Crone's solution) after it was steeped in a suspension of the organism in water (30 millions/c.c.). They grew very well and showed an increase in dry yield by about 30% and in nitrogen content by nearly 80% over the control plants when the latter started dying.

The details of the experiment are being published elsewhere.

Indian Agricultural Research V. ISWARAN.
Institute, ABHISWAR SEN.
New Delhi, June 29, 1959.

TIDAL RHYTHMS OF SOME DIATOMS AND DINOFLAGELLATES INHABITING THE INTERTIDAL SANDS OF THE VISAKHAPATNAM BEACH

It is well known that some marine organisms exhibit persistent rhythmicity of simple physiological events synchronising with the tides.¹⁻⁵ The phenomenon is not only confined to the animals but is also characteristic of a number of minute chlorophyll-bearing protophyta inhabiting the intertidal zone. Aleem⁶ has studied experimentally on the shore and in the laboratory the diurnal periodicity of the diatom community inhabiting the mudflats at Whitstable. Faure-Fremiet reported the tidal rhythms of *Strombidium oculatum*,⁷ *Cromulina psammobia*,⁸ and of *Hantzschia amphioxys*.⁹ The above authors have also reviewed previous literature dealing with tidal rhythms in this group. We are, however, not aware of any such reports from the coasts around India.

While engaged in an ecological survey of the intertidal sands of Visakhapatnam coast¹⁰ we had, on several occasions, observed brown and green patches on the surface of the sand at low tide during the daytime. These were particularly conspicuous during the period February to June. Microscopic examination of the coloured sand in the laboratory revealed that the brown patches comprise populations, almost exclusively, of the diatom *Hantzschia amphioxys* (Ehr.) Grun. var. *capitata* O. Müller and the green patches were due to the presence of numerous dinoflagellates *Gymnodinium splendens* Lebour and a few *Amphidinium pellucidum* Herdman.

Thin films of several such patches were scraped. These were kept evenly spread in fingerbowls, covered with water and exposed to diffuse light from the window in the laboratory. Observations made at regular intervals during the daytime have shown that these organisms periodically come up to the surface synchronising approximately with the time of low tide in their natural habitat. A corresponding downward migration and the consequent disappearance of the coloured patches was observed more or less coinciding with the high tide. Isolated populations seen under the microscope at the time of low tide reacted positively to light. When the same populations were examined at the time of high tide it was found that this phototropic sign was reversed and the organisms reacted negatively to light. During this photophobic phase they secrete a gelatinous substance with the help of which

1. Ashby, S. F., *J. Agric. Sci.*, 1907, **11**, 235.

2. Jensen, J. L., *Proc. Soc. Appl. Bact.*, 1951, **14**, 89.

they agglutinate and cluster around the sand grains.

We have repeatedly failed to observe these patches on the beach when the low tide was during night; nor did the patches in the laboratory show themselves during the night time.

When the observations were continued for three to four days the organisms failed to exhibit any rhythmicity, probably due to "progressive overlapping of the endogenous periods"⁹ under constant laboratory conditions.

On a short visit to Bhimilipatam 20 miles north of Visakhapatnam and on several visits to the backwaters of the Harbour area we have observed similar behaviour exhibited by patches consisting of a community of the diatoms *Pleurosigma æstuarii* Brébisson and of *Nitzschia closterium* (Ehr.).

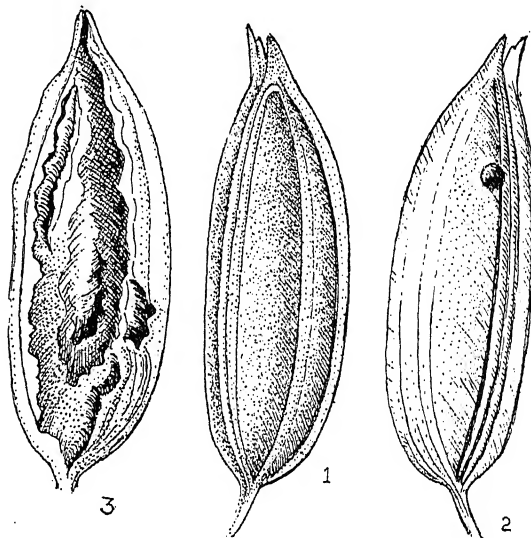
While the full physiological significance of these reactions and how they come into synchrony with rhythmic events in nature are not fully known, Faure-Fremiet⁹ suggests that such responses are probably of great adaptive value for the organisms dwelling in a biotope periodically washed by the waves. Their emergence from the sand at low tide during day-time enables them to carry on the photosynthetic activity normally. Their migration downwards with the advent of the high tide and their capacity to stick to the sand grains with the help of the mucous material secreted during this photophobic phase would prevent them from being washed away thus resulting in the establishment of persistent and flourishing populations.

Dept. of Zoology, P. N. GANAPATI.
Andhra University, M. V. LAKSHMANA RAO.
Waltair, D. V. SUBBA RAO.
July 6, 1959.

A NEW RECORD OF PHYTOPHAGOUS CHALCIDOID IN FENNEL SEED IN INDIA

PHYTOPHAGY amongst Chalcidoids, in recent times, is being increasingly reported and several species belonging to the families Agaonidae, Torymidae, Eurytomidae, Perilampidae and Eulophidae have been recorded infesting vegetative parts of the plants or their fruits and seeds.

The authors while testing seeds of vegetables and condiments observed the Eurytomid *Systole albipennis* Walker causing heavy damage to the seed of fennel (*Foeniculum vulgare* Mill) which is widely grown in India for use as a condiment and is greatly preferred for its medicinal values. No insect has so far been recorded in India causing damage to the seeds of fennel though the same species has been recorded from America.



FIGS. 1-3

Fig. 1. Healthy fennel seed. 2. Infested fennel seed with circular emergence hole of the adult. 3. Completely damaged mericarp.

The nature of damage by the pest is not evident externally till the emergence of the adult insect which leaves a neatly cut circular hole on the surface of seed only after it has completed its development within and emerges from the seed. This suggests that fennel seed is attacked when it is tender and the egg is laid inside the seed. The grub feeds inside the mericarps and renders them hollow.

Generally there was one hole in a mericarp suggestive of the presence of one grub in each seed but sometimes two holes, one in each mericarp had also been observed. Dissection and

1. Brown, F. A. Jr., *American Nat.*, 1957, **91** (858), 129-34.
2. Stephens, G. C., *Ibid.*, 1957, **91** (858), 135-52.
3. Fingerman, M., *Ibid.*, 1957, **91** (858), 167-78.
4. Bruce, G. and Pittendrigh, C., *Ibid.*, 1957, **91** (858), 179-95.
5. Harker, J. E., *Biol. Rev. Cambridge Phil. Soc.*, 1958, **33** (1), 1-52.
6. Aleem A. A., *New Phytologist*, 1950, **49** (2), 174-82.
7. Faure Fremiet, E., *Bull. Biol. France-Belgique*, 1948, **82**, 3-23.
8. —, *Ibid.*, 1950 b, **84**, 207-17.
9. —, *Biol. Bull. Woods Hole*, 1951, **100** (3), 173-77.
10. Rao, M. V. L., "Studies on the ecology of the intertidal sands of the Visakhapatnam coast," *M.Sc. Thesis* (unpublished), 1954.

examination of the seeds further confirmed the presence of two grubs in each seed one in each mericarp. Some grubs were found to be parasitised. Two species of parasites belonging to the families Eulophidae and Torymidae have been reared and were identified as *Tetrastichus* sp. and *Liodontomerus* sp. respectively.

The larvae of *Systole albipennis* are pale yellow in colour and measure 2.5 mm. in length and 0.5 mm. in breadth. The head is deflexed ventrally and is conspicuous by the brown coloured mandibles. The full-fed grub pupates inside the seed and after the completion of pupal period the adult cuts its way out through the covering of the seed as mentioned above. The adults are black in colour. The female can be readily recognised by its larger size. They were reared in the laboratory from August to September.

The percentage of attack in the sample, which was examined, was as high as 30%. As the grub completely consumes the embryo (Fig. 3) the percentage germination of such seeds is greatly affected. The damaged seeds are incapable of germination and the germination test confirmed the above high degree of damage. Unless the seed is critically examined, the damaged seed when sown might lead to patchy germination and greater disappointment. This shows the importance of testing seeds for the damage of insect pests. Further study of this pest and its parasites is in progress. This study is very important not only for the purpose of seed testing but the infested fennel is undesirable in the various uses to which the fennel is put, especially for chewing alone or in the betel leaf by many in India.

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H. N. BATRA.
B. R. SUBBA RAO.
S. K. BHATIA.

June 10, 1959.

AN INTERESTING ENTOMOGENOUS FUNGUS ON GREEN BUG OF COFFEE

Coccus viridis Gr., the green bug attacking coffee in South India, has been known to be affected by two entomogenous fungi: *Empusa lecanii* Zimm. and *Cephalosporium lecanii* Zimm., the former being commonly referred to as the black fungus and the latter as the white fungus. During October-December 1957, and again during April-December 1958, some green bugs on arabica and excelsa coffee bushes at the Coffee Research Station, Balehonnur, were found affected by an orange-red fungus distinct from the black and white fungi men-

tioned above. Infected green bugs were observed on berries (Fig. 1) and leaves of isolated coffee bushes.



FIG. 1. Affected green bugs on coffee berries.

The fungus forms a stroma, involving a half or entire part of the dead body of the insect. The fully developed stroma is leathery soft when moist, but hard when dry, sessile, hemispherical to spherical, smooth, orange-red in colour and measures up to 3 mm. in diam. It is composed of interwoven, branched and sparsely septate hyphae with thick walls and narrow lumen, containing orange coloured oil globules. Within these stroma, pycnidia or perithecia are formed.

The pycnidia are immersed in the stroma and open to the outside by oval or round apertures. The pycnidiospores are unicellular, hyaline, thin-walled, fusiform, pointed at both ends, with one to four (mostly two) guttules, and measure $7.6-9.7 \mu \times 2.0-2.8 \mu$. They are extruded in a cirrus when the stroma comes in contact with water. Paraphyses are absent. The perithecia are immersed, flask-shaped, ostiolate, $250-310 \mu \times 90-165 \mu$ in size. The asci are elongate, clavate-cylindrical, hyaline, blunt at the apex, stipitate, $140-180 \mu \times 5.2-10.5 \mu$, and eight-spored. The ascospores are filiform, hyaline, arranged parallel to each other along the length of the ascus, septate, and break into innumerable fragments at the septa on attaining maturity. The ascospore fragments are cylindrical, rounded at both ends, hyaline, $8.0-9.0 \mu \times 2.5-3.0 \mu$.

Germination of the ascospore fragments was found to be very slow in a 2% glucose solution requiring nearly 2-3 days for the germ tubes to appear.

The fungus has been identified as *Hypocrella olivacea* Petch. The pycnidial stage corresponds to the form-genus *Aschersonia*. *Aschersonia lecanii* Konigsberger et Zimmermann and *A. coffeæ* P. Henn. have both been reported on *Lecanium* on coffee from Java.² The present fungus differs from these in the size of the pycnidiospores (Table I). Pattabhiraman¹ has observed an unidentified orange-red fungus on green bugs. But, in the absence of adequate description it is difficult to determine whether his collection is identical with that under report. To our knowledge, the fungus described in this paper appears to be the first authentic record of its occurrence on green bug of coffee from South India.

TABLE I
Comparison of the size of pycnidiospores of
Aschersonia lecanii, *A. coffeæ*, *Hypocrella olivacea*

Name of the fungus			Size of pycnidiospores in μ
1. <i>A. lecanii</i> ²	..	..	11-14 \times 4
2. <i>A. coffeæ</i> ²	..	..	10-15 \times 2.0-2.5
3. <i>H. olivacea</i>	..	..	7.6-9.7 \times 2.0-2.8

The *Aschersonia* stage of the fungus is commonly observed during the rainy weather, the *Hypocrella* stage becoming more in evidence with the approach of the dry weather.

Herbarium specimens have been deposited at the Commonwealth Mycological Institute, Kew, England (No. IMI 76595).

We are deeply indebted to Mr. Booth, Assistant Mycologist, Commonwealth Mycological Institute, England, for the specific identification of the fungus; to Dr. B. T. Narayanan, Director of Research, Coffee Board, for his keen interest in these studies; and to Dr. P. S. Shekhar, Entomologist, for confirming our identification of the host insect and for providing additional material for study.

Coffee Research Station, T. R. NAG RAJ.
Balehonnur, K. V. GEORGE.
June 6, 1959.

1. Pattabhiraman, T. V., *Eighth Annual Report*, Research Dept., Coffee Board, 1954-55, Bull. 8, 94.

2. Saccardo, *Syll. Fung.*, 15, 488; 18, 412.

MOLYA DISEASE OF WHEAT AND BARLEY IN RAJASTHAN

A SERIOUS disease of wheat and barley, locally known as 'Molya', is prevalent in Jaipur, Sikar, Alwar and Ajmer districts of Rajasthan. This is responsible for losses to the crops annually,

and in certain badly infested fields, practically no grain is formed.

In heavily infested fields, the seedlings are destroyed before emergence or almost as soon as they emerge, resulting in thin and irregular stand. The surviving plants remain stunted and show yellowing of leaves. The root system gets reduced in size and becomes bunched with profuse development of thinner rootlets. The affected roots and rootlets, with soil sticking to them, show characteristic swellings.

The presence of a parasitic sucking type of nematode was observed in the soil and roots. Small, rounded, lemon-shaped, white to dark-brown coloured bodies of the size of 0.2 mm. to 0.5 mm. were invariably associated with the roots of the diseased plants late in the season. The lemon-shaped bodies were found to be full of larvae of the nematodes indicating that they were the cysts. Pathogenicity of the nematode was established by growing wheat in pots filled with inoculated and sterilized soils; the plants showed typical disease symptoms in the former and normal healthy growth in the latter.

The cysts are symmetrical, hard, exposed on root surface, attached by neck, dark brown when mature with obtuse vulval cone and bullae close to vulval slit. They have thick white crystalline layer when young. The cyst forming nematode responsible for the disease has been identified as *Heterodera avenae* Wollenweber [synonym *H. major* (O. Schmidt) Franklin]. The parasite has been reported on graminaceous hosts in United Kingdom and Australia,¹ but this appears to be the first record from India. Further work on this problem is in progress.

The authors are grateful to Mr. F. G. W. Jones of Rothamsted Experiment Station, Harpenden, for identification of the nematode.

Plant Pathology Section, N. PRASAD.
Agriculture Department, R. L. MATHUR.
Rajasthan, Udaipur, S. P. SEHGAL.
July 25, 1959.

1. Rolfe, S. W. H., *Plant Nematology Tech. Bull.*, Ministry of Agriculture, Fisheries and Food, London, 1959, 7, 95-100.

CHROMOSOME NUMBERS IN GRAMINEAE

THE chromosome numbers of five genera and fifteen species of the tribe *Paniceae* were investigated and are reported in Table I. The panicles were fixed in propionic alcohol (1:3) and the anthers were squashed in propionocarmine. Root-tips were fixed in Karpechenko's fluid, and stained in crystal violet.

TABLE I

Species	Source	Chromosome number		Previous report	
		<i>n</i>	<i>2n</i>	<i>2n</i>	Author
<i>Urochloa reptans</i> Stapf.	.. Coimbatore	7	..	..	..
<i>U. mosambicensis</i> (Hack.) Dandy	.. Botanic Gardens, Coimbatore (Exotic sp.)	14	..	28	Joginder Nath and Swaminathan, 1957
				30	de Wet and Anderson, 1956
				42	Darlington and Wylie, 1955
<i>U. setigera</i> Stapf.	.. Coimbatore	18	..	..	..
<i>U. panicoides</i> Beauv.	.. Top slip, Coimbatore	24	..	30, 36	Darlington and Wylie, 1955
<i>Eriochloa procera</i> C. E. Hubbard.	.. Coimbatore	18	..	..	..
<i>Paspalidium geminatum</i> Stapf.	.. do.	9	..	40 (as <i>Panicum geminatum</i>)	do.
<i>P. flavidum</i> A. Cam.	.. do.	27	..	72	do.
<i>Digitaria marginata</i> Link.	.. do.	27	..	36-48, 54 (as <i>D. sanguinalis</i>)	do.
<i>D. marginata</i> Link.	Kurudimalai, Coimbatore	18	..	..	..
var. <i>imbriata</i> Stapf.	.. Topslip, Coimbatore	27	..	..	..
<i>D. griffithii</i> Stapf.	.. Coimbatore	27	54	..	..
<i>Setaria intermedia</i> R. & S.	.. do.	27	54	18	Darlington and Wylie, 1955
<i>S. verticillata</i> Beauv.	..			36	do.
<i>S. splendida</i> Stapf.	.. Australia	..	36	63	de Wet and Anderson, 1956
				54	
<i>S. woodii</i> Hack.	.. do.	..	18	..	..
<i>S. holstii</i> Herrm.	.. do.	..	30	..	..
<i>S. sp.</i> (received as <i>S. superba</i>)	.. do.	..	36	..	..

The chromosome number of *Urochloa panicoides* ($n = 24$) is the highest recorded for the genus and suggests a new basic number ($x = 12$). The chromosome number ($n = 9$) of *Paspalidium geminatum* is the lowest recorded for the genus and indicates a true diploid race. The meiotic pairing was normal in all the species except in *Urochloa mosambicensis* where the association was often $2_{IV} + 10_{II}$.

The authors are thankful to the Systematic Botanist and Professor of Botany, Coimbatore, for the supply of *Urochloa mosambicensis* and to Dr. William Hartley of the Commonwealth Scientific and Industrial Research Organisation, Canberra, for supplying the seeds of *Setaria* species.

Agric. Research Inst., V. S. RAMAN.
Coimbatore-3, P. CHANDRASEKHARAN.
March 9, 1959. D. KRISHNASWAMI.

CHROMOSOME NUMBERS IN SOME GRASSES

In the course of studies on forage grasses in relation to their chromosomal races, the following chromosome numbers were determined. The counts are believed to be new in the sense that chromosome numbers for some of these items do not appear to have been listed in the literature (Darlington and Wylie, 1955 and subsequent publications) or the numbers recorded here are different from those reported earlier.

As would be seen from Table I, there are indications of the existence of intraspecific chromosome races, as for instance in the case of *Pennisetum subangustum* S. & H. and *Panicum coloratum* L., besides *Pennisetum pedicellatum* Trin. and *Iseilema laxum* Hack. The entire grass collection in the Division is being studied from the point of view of, among other things, relationship between the various plant characters and chromosome numbers.

Material was fixed in acetic alcohol saturated with ferric acetate and stained in propionocarmine according to the schedule described by

1. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, George Allen and Unwin Ltd., 1955, 519.
2. de Wet, J. M. J. and Anderson, L. J., *Cytologia*, 1956, 21, 1.
3. Joginder Nath and Swaminathan, M. S., *Indian J. Genet.*, 1957, 17, 102.

TABLE I

Sl. No.	Species	Source	I.A.R.I. Accession No.	Chromosome numbers		
				Present material (n)	Previous reports	Author
1	<i>Pennisetum subangustum</i> S. & H.	W. Africa	E.C. 13267	12	2n=36	Krishnaswamy <i>et al.</i> (1954)
2	<i>Pennisetum subangustum</i> S. & H.	W. Africa	E.C. 13267	16	..	..
3	<i>Pennisetum pedicellatum</i> Trin.	.. Ajmer (India)	I.W. 1685	24	2n=36 and 54	Swaminathan and Nath (1956)
4	<i>Ischaemum aristatum</i> Linn.	.. Bombay (India)	I.W. 1056	12	..	..
5	<i>Setaria spathuliflora</i> Blatter & McCann.	Bombay (India)	I.W. 1040	10	..	..
6	<i>Setaria sulcata</i> Camus.	.. Bhopal (India)	I.W. 1505	10	..	..
7	<i>Chrysopogon lancearius</i> Haines	Andhra (India)	I.W. 1423	10	..	..
8	<i>Iseilema laxum</i> Hack.	.. Nagpur (India)	I.W. 1505	14	n=4	Celavie and Paliwal (1957)
9	<i>Iseilema wightii</i> Anders.	.. Thana (India)	I.W. 1686	14	2n=36	Ramanathan (1950)
10	<i>Panicum coloratum</i> L.	.. Australia	E.C. 14124	18	n=18 +1 to 3 B chromo-somes	Swaminathan and Nath (1956)
11	<i>Panicum coloratum</i> L.	.. Australia	E.C. 14125	16	..	..
12	<i>Panicum coloratum</i> L.	.. Australia	E.C. 14126	9	..	..
13	<i>Elyonurus hirsutus</i> Munro.	.. Rajasthan (India)	I.W. 1487	9	..	..

Swaminathan *et al.* (1954) for pollen mother cells. Chromosome counts were made at diakinesis and metaphase I.

Division of Botany, A. B. JOSHI.
Indian Agri. Research Inst., B. D. PATIL.
New Delhi-12, P. L. MANCHANDA.
June 8, 1959.

1. Celavie, R. P. and Paliwal, R. L., *Science*, 1954, 126, 1246-48.
2. Darlington, C. D. and Wylie, A. P., *Chromosomal Atlas of Flowering Plants*, George Allen and Unwin Ltd. (London), 1955.
3. Krishnaswamy *et al.*, *Heredity*, 1954, 23, 64.
4. Ramanathan, K., *Curr. Sci.*, 1950, 19, 155.
5. Swaminathan, M. S. and Nath, J., *Nature*, 1956, 178, 1241-42.
6. —, *Curr. Sci.*, 1956, 25, 123-24.
7. Swaminathan *et al.*, *Indian J. Genet. Pl. Breed.*, 1954, 14, 87-88.

CHROMOSOME NUMBER IN *CERATOPTERIS SILIQUOSA* (L.) COPEL.

THE systematic position and affinities of the genus *Ceratopteris* has long been questioned. Recently Ninan (1956) has determined the chromosome number of *Ceratopteris thalictroides* (= *C. siliquosa*; Copeland, 1947) and tried to ascertain its phylogenetic relationship on the basis of cytological observations. He found the presence of 77 bivalents in meiosis and 154

chromosomes in the root-tip cells. It is interesting to note that his observation agrees substantially with that reported (76-78 bivalents) by Manton (1954) from specimens collected from Malayan peninsula.

Cytological studies of *Ceratopteris siliquosa* * collected from the suburbs of Calcutta showed the presence of 40 bivalents in the spore mother cells and 80 chromosomes in the somatic complement. The accompanying figure which has

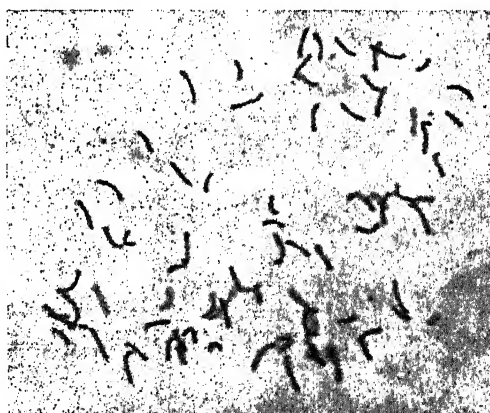


FIG 1. *Ceratopteris siliquosa*. Somatic Chromosomes, $\times 1,600$.

* The material has been identified from the Indian Botanic Garden and confirmed by the authorities of the Royal Botanic Garden Herbarium, Kew, England.

been obtained from aceto-orcein squash preparations of the root-tips pretreated in a mixture of 1 part of Newcomer's fixative and 3 parts of saturated aqueous caumarine solution for 1½ hour at 15° C., followed by fixation in 1:3 acetic alcohol for an hour shows the presence of 76 somatic chromosomes, 4 being out of focus. Repeated counts, from plants obtained from different localities round about Calcutta, always showed the same number ($n = 40$; $2n = 80$). It may be mentioned that according to Ninan, most of the somatic chromosomes have median and submedian constrictions, 2 of which are satellited out of 154. Our observation shows that the chromosomes with subterminal centromere are greater in number than those with median and submedian. Four pairs of Sat-chromosomes are also noted in the somatic complement.

Ninan (1956) has discussed the validity of the opinions of different authors regarding the affinities and phylogeny of the genus *Ceratopteris*. He questioned the plausibility of Bower's (1928), Holttum's (1947) and Copeland's (1947) views on the interrelationship of the genus and position of the same in the systematic classification of the former two authors. He, however, supports Bower's (1928) suggestion of its origin from the Osmundaceous stock on the contention that all these are traceable back to 11-chromosomed ancestors. In the light of the present investigation on *Ceratopteris siliquosa* and on the basis of the argument advanced by Ninan, it seems quite appropriate to consider the genus closely related to those forms having $n = 10$ or its multiples. Thus the inclusion of the genus within *Gymnogrammoideæ* by Bower (1928), in *Adiantaceæ* by Holttum (1947), Copeland's (1947) suggestion of Pterid ancestry of *Ceratopteris* and Copeland's (1947) and Stokey's (1951) opinions that the later has close affinity with *Cheilanthes* group of ferns cannot be refuted.

It is, however, difficult to say anything definitely as it is extremely likely that there are different races of *Ceratopteris siliquosa* characterised by different chromosome numbers.

The detailed study of the life-history of *C. siliquosa* is nearly complete and is expected to be published elsewhere.

Grateful acknowledgement is made to the Ministry of Education, Government of India, for awarding me a Research Training Scholarship and my thanks are due to Dr. I. Banerji under whose guidance and encouragement this work has been carried out.

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OCCURRENCE OF FOSSIL ALGA, PROBABLY *ULOTHRIX*, IN TERTIARY BEDS OF MOHGAON-KALAN LOCALITY (M.P.), INDIA

With the increasing discovery of algal specimens from the exposed Tertiary beds of the Deccan Intertrappeans at Mohgaon-Kalan, it is evident that fossil representatives of Chlorophyta occur in abundance. Most of the algal types which have been described so far belong to the group Chlorophyta (grass-green algæ) and the present fossil alga is an addition to this group.

A few filaments of *Spirogyrites* gen. nov., closely resembling the living *Spirogyra*, were reported for the first time from the above locality (Shukla, 1950), and this discovery led many students of palæobotany to study the algal flora of the same bed either with the help of peel sections or maceration methods. Maceration of a promising chert material from the Mohgaon-Kalan has yielded an excellently preserved fragmentary filament of *Oedogonites* gen. nov. closely resembling the freshwater alga *Oedogonium* in most of its characters (Dwivedi, 1959).

A large specimen of chert suspected to contain numerous petrified microfossils was sliced into many pieces of suitable size. One of the slices from the mid-region of the chert found to be the richest was selected for obtaining peel sections. Several such were obtained, cut into suitable size and mounted in Canada balsam (Dwivedi, 1959). One of the peel sections, when carefully examined, unexpectedly revealed excellent preservation of fragmentary and unbranched algal filaments. About 25 such broken filaments were counted (Fig. 1). Perhaps due to their soft nature, the filaments are fragmentary (Haupt, 1953) but they were found occurring as petrifications which is supposed to be the best type of preservation (Johnson, 1951). The fragmentary algal filaments are so charac-

teristic that these immediately remind us strongly of the freshwater alga *Ulothrix*.

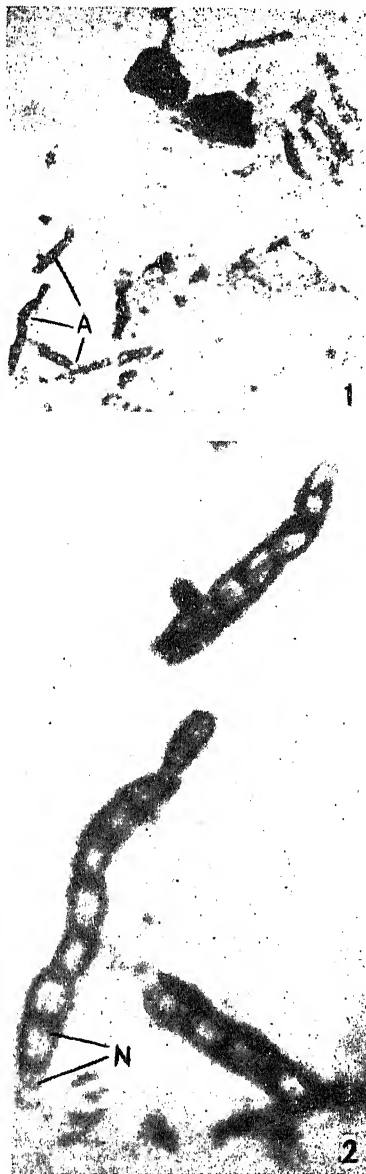


FIG. 1. A few fragmentary and unbranched algal filaments (A), $\times 300$.

FIG. 2. Three pieces of the algal filaments highly magnified and showing nucleus (N) inside cells, $\times 1,200$.

The fragmentary algal filaments are unbranched and exhibit excellently preserved cell walls. The cells of the filament are joined end to end and are similar to the cells of the living genus *Ulothrix*. In a few cells the single nucleus-like body is visible (Fig. 2). The broad gelatinous sheath round the filament,

reported in some species of *Ulothrix*, is not seen in the cells (Smith, 1955). Probably the fossil alga is one of the forms where the gelatinous sheath is absent. The girdle-shaped chloroplast with the pyrenoids, one of the important characters of the sub-order *Ulotrichinae*, however, is not preserved and thus not visible in the specimen. In none of the pieces of the algal filament, the rhizoidal basal cell, known as holdfast, is seen. This fact leads us to believe that all the 25 pieces of the filament are from the distal end of the plant thallus. The present specimen is probably in the vegetative stage, no reproductive and asexual bodies being developed so far.

The fossil alga resembles the freshwater alga *Ulothrix* in some characters. Some of the important characters could not be studied due to imperfect preservation. It is probably one of the species of the existing genus *Ulothrix* where the gelatinous sheath is absent. With the discovery of the present fossil alga in the Tertiary rocks it becomes evident that members of the order *Ulotrichales* were also represented in the early Tertiary beds (Eocene) which is supposed to be 60,000,000 years old (Sahni, 1934).

The author wishes to express his deep sense of gratitude to Dr. M. R. Sahni, Panjab University, for valuable suggestions and for going through the manuscript.

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ON THE STRUCTURE AND MECHANISM OF THE SPIRACULAR REGULATORY APPARATUS IN THE ADULT *CORCYRA CEPHALONICA* STAINT.

THE spiracular regulatory mechanism plays an important role both in gaseous exchange and in diffusion of water vapour.³ The absence of this mechanism in *Onychophora* is one of the

limiting factors in their evolution and accounts for their restricted habitat.² In contrast, most insects are able to control these two important processes by means of what is termed as "tracheal closing apparatus" which is situated at the primary or secondary tracheal orifice. It has been a legitimate supposition that the successful evolution of insects as a group of terrestrial organisms has been largely facilitated by the presence of tracheal closing apparatus which also helps in the conservation of water, so very necessary for the vital activities of living protoplasm.^{2,3}

There is a significant lack of literature on this subject of the spiracular morphology of the stored grain pests. The only relevant work is that of Abbott (1929) who made a study of the spiracles of two species of weevils. The present communication aims at giving the details of the functional morphology of the spiracles of *Corcyra cephalonica* Staint.

Nine pairs of spiracles occur in this species. They are similar in their structure and mechanism, with, however, a slight variation in the size of their atria. Thoracic spiracles are larger than the abdominal ones. The first pair of spiracles is situated in the intersegmental membrane just behind the pronotum. The abdominal spiracles occur on the edges of the tergites.

Each spiracle is surrounded by a bean-shaped peritreme, from which arise minute hairs directed against the spiracular opening (Fig. 1).

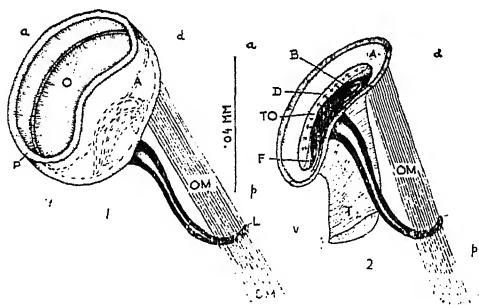


FIG. 1. Prothoracic spiracle, external view. Surrounding membrane is not shown.

FIG. 2. Diagrammatic sectional view of the 4th abdominal spiracle to show the closing mechanism.

a—anterior; p—posterior; d—dorsal; v—ventral; A—atrium; B—bridge; D—elastic bend; DM—dilator muscle; F—membranous fold; L—lever; O—spiracular opening; OM—occlusor muscle; P—peritreme; T—trachea.

These hairs extend for a short distance inside the atrium and thus serve as a filter mechanism. The walls of the atrium are sclerotic and form a cup-like cavity below the integument. A part of the atrial wall is more thickened and forms

a base for closure, the bridge (B). A strong lever (L), which is flexibly articulated with the bridge, lies at the tracheal entrance. The head of the lever extends from one side in the form of an elastic band (D) round the remaining half of the tracheal tube opposite the bridge. A closing muscle is composed of a number of parallel bundles of fibres. It is attached to the distal end of the lever and to the atrial wall near the bridge. A similarly shaped dilator muscle is inserted at the distal end of the lever and arises from a postero-ventral notch on the tergite. A second dilator muscle which is present in some Lepidoptera was not noticed in this species and is apparently absent.

On contraction of the occlusor muscle the closure is effected as the free head of the lever and consequently the band is pressed against the bridge (Fig. 2). Opening is regained on relaxation of the occlusor muscle and simultaneous contraction of the dilator muscle. The latter is antagonistic in action. Thoracic and abdominal spiracles do not vary in significant detail except that the latter have a shallow atrium. Judging from the anatomy, the closing mechanism seems to be hermitic.

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A PRELIMINARY NOTE ON PHAGE TYPING OF STAPHYLOCOCCI WITH PARTICULAR REFERENCE TO STRAINS FROM BOVINE UDDER ORIGIN*

IN India very little work seems to have been done on Bacteriophage typing of Staphylococci particularly from that of bovine udder. Saxena¹ tested 54 bovine udder strains, out of which only 30 were susceptible to phages. In other countries most of the workers²⁻⁶ found 80 to 95% bovine udder strains typable by bacteriophage method; some of them^{4,5} divided the strains into 4-5 phage types. Mac Donald,²

Smith,³ Edwards and Rippon⁵ reported phage 42 D to be most predominant having lytic property on udder strains from England, whereas Seto and Wilson⁶ and Mc Lean⁷ found in U.S.A. and Australia majority of strains susceptible to phage 44 A. Saxena,¹ Assa,⁸ and Wallmark and Thorne⁹ concluded that phages used for typing human strains were in many cases not very suitable for typing animal strains.

In the present report 63 coagulase positive strains (44 from bovine udder, 3 from caprine mastitis cases, 1 from sheep abscess and 15 human strains particularly from milkers acting as normal carriers) and 17 coagulase negative strains (10 from bovine udder and 7 from caprine mastitis cases) were studied against 10 standard phages (6, 42 D, 42 E, 42 F, 44, 52, 78, 105, 107 and 111) obtained through the courtesy of Dr. Williams, Staphylococcal Reference Laboratory, Colindale, and Dr. Davidson, Central Veterinary Laboratory, Weybridge. The phage typing technique of Wilson and Atkinson¹⁰ modified by Williams and Rippon¹¹ was followed using phages in the routine test dilution (RTD).

Out of 44 coagulase positive bovine udder strains 38 (86.4%) were typable. Except 2

It can be inferred from Table I that phage 78 showed least activity and 42 F the most. In most of the cases phages 42 D and 52 showed weak reactions. Phages 6, 78, 44, and 111 showed only strong reactions, although the first 2 phages showed little activity on the whole. Phages 105, 107 and 111 showed equal percentage of strong reactions.

Individual strains were generally attacked by several phages. Thus all the 40 strains (38 bovine and 2 human) were lysed strongly by one or more phages. Of the 27 strains lysed strongly 7 were affected by a single phage. The number lysed strongly by 2, 4, 5, 6, 7 and 10 phages were 2, 1, 4, 4, 7 and 2 strains respectively.

The 38 bovine strains typable by phage method were arranged into 4 different phage types on the basis of reactions shown by them. Out of these 18.5% belonged to phage type 1, 23.7% to phage type 2, 52.7% to phage type 3 and 5.1% to phage type 4. Both the human strains were assigned different phage types. It is probable that other phage groups might exist if large number of strains are studied which may throw more light. Other untyp-

TABLE I
Frequency of occurrence of phage reaction Patterns among 40 strains

Sl. No.	No. of strains and origin	Phage patterns		Phage types
		Strong reactions	Weak reactions	
Bovine strains				
1	7	52/44/42D/42F/105/107/111	..	1
2	4	44/42D/42F/105/107/111 +	..	2
3	4	44/42F/105/107/111 +	..	
4	1	42F/105/107/111 +	..	
5	4	..	52/42D/42F	3
6	5	42F +	52/42D	
7	1	..	52/42D/42F/105/107	
8	1	..	52/42D/42F/107	
9	3	..	52/42D/42F/105	
10	4	..	52 42D/105/107	
11	1	42F +	52/42D/105/107	
12	1	42F +	52/42D/105	4
13	2	52/44/6/42E/42D/42F/78/105/107/111	..	
Human strains				
14	1	6/44 +	..	5
15	1	42D/42F	..	6

human strains, none of the coagulase positive strains from caprine, ovine and human sources was susceptible to any of the phages; Similarly 17 coagulase negative strains included in this study were also untypable. It is indicated from the results shown in Table I that the susceptibility of 40 typable strains varies from 5 to 95% to individual phages,

able strains required the help of extra phages for typing.

The percentage of typable strains and number of phage types are comparable with the results of other workers mentioned earlier. It is interesting to note that 100% typable strains from bovine udder origin were susceptible to a single phage 42 F which is different from the

observations made in England, Australia and U.S.A. where phages 42 D and 44 A were reported occurring predominantly.

The authors gratefully acknowledge the kind help of Dr. R. E. O. Williams and Dr. I. Davidson for supplying the phages and the latter also for confirmation of the results.

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EFFECT OF GRAFTING ON FRUIT-SET AND EMBRYO DEVELOPMENT IN CROSSES BETWEEN *CORCHORUS OLITORIUS* AND *C. CAPSULARIS*

THE two important cultivated species of jute, *Corchorus olitorius* L. and *C. capsularis* L. have both the somatic chromosome number $2n=14$, nearly identical karyotypes and characters which can ideally supplement the needs of each other, but all attempts to cross directly the two species at diploid or tetraploid level have so far remained unsuccessful.^{1,2} Ganesan *et al.*,³ found that in crosses with *C. capsularis* as the pistillate parent, the flowers dropped within three days after pollination, while with *C. olitorius* as the pistillate parent viable seeds could not be obtained owing to the premature abortion of the young embryo at the globular stage.

We have tried various techniques during 1957 and 1958 to make the hybrid embryo grow at least to the heart shaped stage so that the embryo can be excised and cultured artificially on a suitable medium. The techniques tried included smearing the ovary with various hormones, use of X-rayed pollen for crossing, using plants raised from irradiated seeds as

parents and lastly, grafting the two species reciprocally and using the grafted plants for crossing. Among these, grafting gave some interesting results, which are summarised in this report.

Simple cleft grafts proved successful and *C. olitorius* and *C. capsularis* were found to be graft-compatible (Figs. 1 and 2). Reciprocal

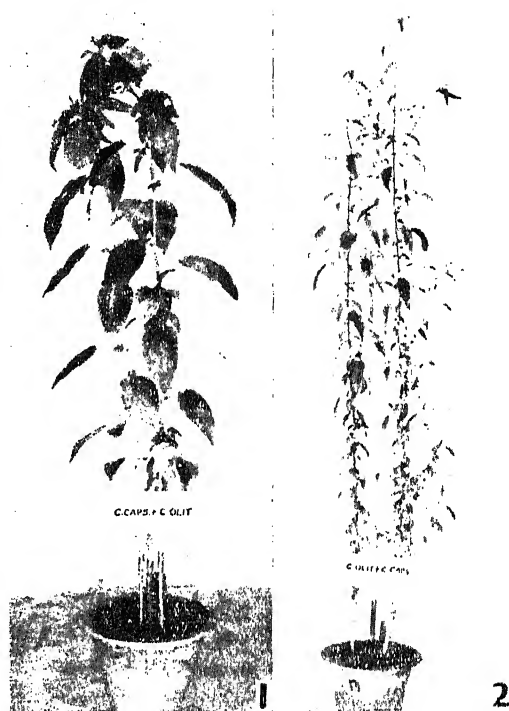


FIG. 1. *C. olitorius* grafted on *C. capsularis* root stock.

FIG. 2. *C. capsularis* grafted on *C. olitorius* root stock.

crosses were done and fixation of the ovaries and style was made at regular intervals after pollination. Microtome sections were stained in iron-haematoxylin. Embryo and embryonic dissections were also carried out. The results of the study are given in Table I.

From the data it is clear that firstly, grafting while increasing the percentage of fruit setting, did not lead to any marked improvement in the growth of the hybrid embryo when *C. olitorius* was used as the pistillate parent and secondly, in crosses with *C. capsularis* as the pistillate parent, there was a striking increase in the percentage of fruit-set. The ovules dissected between 13 to 16 days after pollination in crosses made with grafted plants as parents, had globular proembryos. However, the mature seeds were in all cases shrivelled and empty. The free nuclear endosperm failed to become cellular in all the crosses. On the other hand no hyperplasia or any other morphologically

TABLE I

Cross	Fruit-set %	State of development on different days after pollination					
		1	7	10	15	20	35-40
<i>C. rectorius</i> selfed or <i>C. capsularis</i> selfed	100	Pollen tube enters the embryo sac	Zygote Endosperm free nuclear	Globular pro-embryo Endosperm free nuclear	Embryo at torpedo stage Endosperm cellular	Embryo with well differen- tiated cotyledons Endosperm cellular	Mature dicoty- ledonous embryo surrounded by the endosperm
<i>C. olitorius</i> × <i>C. capsularis</i>	42.3	"	"	10-12 celled proembryo Endo perm free nuclear	10-12 celled proembryo Endosperm free nuclear	10-12 celled proembryo Endosperm free nuclear	*Shriveled seeds with abortive embryo and degenerated endosperm
<i>C. olitorius</i> grafted on <i>C. capsularis</i> × <i>C. capsularis</i>	66.5	"	"	"	"	"	"
<i>C. capsularis</i> × <i>C. olitorius</i>	5	"	"	Empty ovules			Empty shrivelled seeds
<i>C. capsularis</i> grafted on <i>C. olitorius</i> × <i>C. olitorius</i>	25	"	"	Ovules with globular proembryos			Empty shrivelled seeds

*Occasionally heart-shaped embryos were also observed.

detectable abnormality was observed in the nucellus or integumentary cells. Since both the embryo and endosperm are of hybrid origin there may be a common cause for their inability to grow and differentiate normally. It seems probable that complimentary genetic lethals control the early embryo lethality in this cross and thus serve as the isolation barrier necessary to preserve the individual distinctness of the two species. Mechanisms such as chromosomal differentiation or geographical isolation consequently seem to have been unnecessary for this purpose. Hence, in addition to attempts to modify the physiological environment of the hybrid embryo by techniques such as grafting or using a 'bridge' species in the cross⁴ or ovary and ovule culture, it may be worthwhile trying to induce mutations that will inactivate the incompatibility reaction.

We are grateful to Dr. B. P. Pal, Director, and Dr. A. B. Joshi, for their interest in the study. Our sincere thanks are due to Shri R. D. Iyer and Shri K. L. Gupta for their technical assistance.

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CYTOLOGICAL OBSERVATION ON *PERIPLANETA AMERICANA*

CYTOLOGICAL data on Blattidæ are recorded by Stevens,¹ Wassilieff,² Morse,³ Harvey,⁴ Mathey,⁵ Schrader,⁶ Suomalainen.⁷ The present study adds more information regarding meiosis of *Periplaneta americana*.

The testes were fixed in Belling's modification of Navashin's mixture. Sections were cut at 10-15 μ and stained in iodine crystal violet and Feulgen light green.

Spermatogonial prophase nucleus are vacuolated with indistinguishable chromatin threads, which are thinly scattered throughout the nucleus with a little more aggregation towards the periphery. Innumerable bipartite chromatin dots with circular space around them are visible. The big heteropycnotic X-chromosome is centrally or eccentrically placed often with the nucleolus.

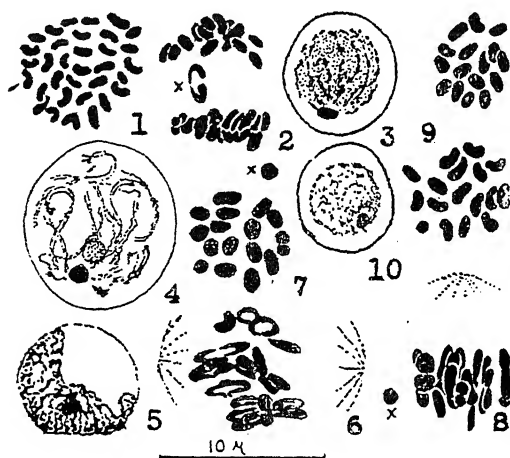
Resting cells at primary spermatocyte are similar to the spermatogonial prophase except in its smaller size and comparatively dense heteropycnotic mass.

Size-variation of X in the early spermatogonial and early meiotic cells are due to the association of other heteropycnotic bodies with it. A proportional decrease in the volume of X is viewed when other heteropycnotic bodies are separated from it.

Diplotene seems to be absent. The diakinesis is brief with a pronounced "pre-metaphase stretch". Chiasmata cannot be detected in any one of these stages. The orientation of the homologous pairs simulate a true picture of

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terminalization of one or two chiasmata. Taking an indirect view of the existence of chiasmata a mean frequency and terminaliza-



FIGS. 1-10. Fig. 1. Spermatogonial metaphase. Fig. 2. Spermatogonial anaphase. Fig. 3. Leptotene boquet. Fig. 4. Second polarization. Fig. 5. Late pachytene. Fig. 6. Premetaphase stretch. Fig. 7. Metaphase I, polar view. Fig. 8. Metaphase I, side view. Fig. 9. Metaphase II, polar views. Fig. 10. Early spermatid.

tion coefficient in diakinesis and metaphase are given below :

Stages of Meiosis	No. of nuclei	Total no. of Xta.	Total no. of terminal Xta.	Terminaliza- tion coefficient	Mean chiasma frequency per nucleus
Diakinesis	.. 11	174	149	0.86	15.82
Metaphase	.. 21	340	319	0.94	16.19

The first division is reductional for the sex chromosomes. Second division metaphase plates having 16 and 17 elements without or with X-chromosomes respectively are found in equal proportion. The division is equational.

Each early spermatid contains loosely sparsed and feebly stained chromatin matters with an eccentrically placed heteropycnotic X-chromosome.

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FEEDING HABIT OF SUGARCANE SCALE (*TARGIONIA GLOMERATA* GREEN)

THE note relates to the study of the feeding habit of the sugarcane scale, *Targionia glomerata* Green through histological observations on attacked sugarcane material.

Portions of the heavily infested stem of the highly susceptible sugarcane variety Co. 745, were fixed in Carnoy's fluid (Acetic acid-1 : chloroforma-3 ; Absolute alcohol-6) for half an hour. Thin sections of the fixed stem were taken by means of a hand microtome, stained in safranin and mounted in Canada balsam

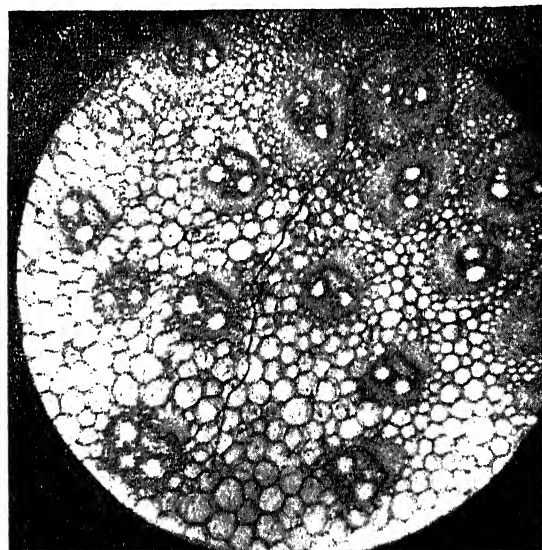


FIG. 1. Showing stylet probing towards the pith region, after dehydration through alcohol series. The sections were mounted under the microscope and the passage of the insects' stylets through the tissues observed.

The stylet consists of four chitinous filaments which are made into a tube-like structure for sucking food material. In the grown-up insects these stylets are long measuring up to 4.05 mm., the diameter varying from 4.2 to 5.3 μ . It was observed that the stylets penetrates through the epidermis and go deep inside the stem almost near the pith region (Fig. 1). They make their way through the parenchymatous cells of the

ground tissues and clearly avoid the vascular bundles (Fig. 2). They do not seem to penetrate through the bundles. If the latter happen to lie on their way, the stylets curve round the bundles and pass through the parenchymatous cells. It would, thus, appear either that the insect does not like the food material contained in the vascular tissue or the stylet is not able to penetrate the hard lignified cells of the vascular bundles. This is not in agreement with the views expressed by Davidson,² Horsfall,³ Smith and Poos⁵ and others, that sucking insects feed even on vascular tissues of the stem and leaf. Further, the entry of the stylet is noticed to be always intracellular. In the case of *Aspidiotus hederæ* Vallot, an allied scale insect, Smith⁴ has also observed the intracellular path of the stylets and their definite avoidance of the phloem cells in a species of *Cordyline*.

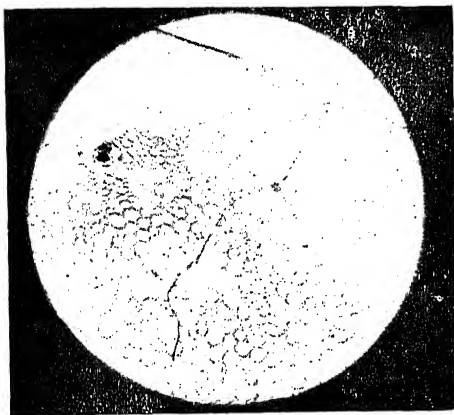


FIG. 2. Showing stylet clearly avoiding the vascular bundles.

This tendency of the stylets probing into the parenchymatous cells of the ground tissue at the same time avoiding the vascular bundles would indicate that the insect sucks its food material from the parenchymatous cells, unlike *Perkinsiella saccharicida*¹ Kirk. which draws its food material from the phloem tissues.

The authors are thankful to Dr. N. R. Bhat, Director, for his useful suggestions during the work.

Sugarcane Breeding Inst., R. A. AGARWAL.
Coimbatore-7, DURGA P. SHARMA.
July 9, 1959. P. A. KANDASAMY.

5. Smith, K. M. and Poos, F. W., *Jour. Agri. Res.*, 1931, 47, 475-85.

A VARIETY OF *BACILLUS MEGATHARIUM* CAUSING ROT OF GERMINATING PEA

DURING efficiency tests of some strains of *Rhizobium* from pea (*Pisum sativa* var. *bonneville*) seeds, treated with mercuric chloride-alcohol for surface sterilisation, failed to germinate in an incubator at 30° C. The seeds were at first seen to be covered with a gummy mass and then to disintegrate completely due to rotting in a short time. On examination, they were observed to contain an organism, which appeared to be a variety of *Bacillus megatharium*. The characteristics of the organism are described below:

Aerobic, capsulated, highly motile rods in short and long chains, having several granular bodies in each cell, spore-former, vegetative cells: 0.92-1.54 μ \times 3.08-6.16 μ ; spores: 0.77-1.08 μ \times 1.54-2.77 μ , no swelling of the mother cell, gram positive with a tendency towards gram variability, whitish rhizoid colonies on nutrient agar, dry whitish growth on potato, rapid growth at 30° C., production of acid but no gas from sugars, reduction of nitrates to nitrites and ammonia, liquefaction of gelatin, V.P. negative, diastase positive, indol negative, peptonisation and acidity in milk, utilisation of citrate as sole source of carbon, active ammonification.

The organism differed from *Pseudomonas seminum* (Cayley, 1917), a seed-borne organism, affecting germination and growth of pea (Elliot, 1951) in its capacity to hydrolyse starch, and from common *B. megatharium* in its ability to reduce nitrates to nitrites rather freely (Breed, Murray and Smith, 1957). Apart from pea, the organism affected the germination of *khesari* (*Lathyrus sativus*), sunnhemp (*Crotalaria juncea*, methi (*Trigonella Fænum-Græcum*), lucerne (*Medicago sativa*), berseem (*Trifolium alexandrinum*) and maize (*Zea mays*), but could not affect gram (*Cicer arietinum*). Rotting of the seeds, could be prevented only by carrying the germination in cold and by putting the seeds in unsterilised soil.

Indian Agri. Res. Institute, K. G. GUPTA.
New Delhi, ABHISWAR SEN.
July 10, 1959. R. B. REWARI.

1. Barber, F. G. and Robinson, P. E., *Proc. 7th I.S.S. C.T.*, 1950, 155-67.
2. Davidson, J., *Ann. app. Biol.*, 1923, 10, 679-712.
3. Horsfall, J. L., *Pa. Agri. Expt. Stn. Bull.*, 1923, 182, 22.
4. Smith, K. M., *Ann. app. Biol.*, 1926, 13, 109-39.

Cayley, *Proc. Roy. Soc.*, 1917, 86 B, 171-73.
Elliot, *Manual of Bacterial Plant Pathogens*, Walltham, Mass, U.S.A., 1951, 87.
Breed, Murray and Smith, *Bergey's Manual of Determinative Bacteriology*, 7th Ed., 1957, 616.

REVIEWS

Modern Geometrical Optics—Pure and Applied Mathematics. Vol. VIII. By Max Herzberger. (Interscience Publishers, New York), 1958. Pp. xii + 504. Price \$ 15.00.

With the rapid development in the manufacture of precision optical instruments, the need has arisen for a comprehensive and authoritative book on the theory of lenses and optical systems which will be useful not only to the designers who make them but also to the research workers who use them. The author, Max Herzberger of Eastman Kodak Company, is well known in this field and every chapter in the book bears testimony to the years of experience that lie behind the writing.

The book is divided into eight parts with divisions of chapters which develop the subject of theoretical lens technology in a systematic manner, deriving and recasting the formulæ in a form suitable for use with the modern high speed electronic computers to obtain the data required by the designers.

Part I deals with the methods of ray tracing through different types of optical systems. Part II deals with Gaussian optics whose laws are strictly applicable to axial rays: the deviations of these laws for actual rays constitute the conventional aberrations. Part III is of great theoretical interest as it deals with the most important discovery in geometrical optics, namely, the Hamilton equation which contains implicitly all the laws of optical image formation, and can be adapted to any special problem. As we pass from single ray tracing through an optical system, to tracing a manifold of rays, Hamilton's equation becomes of particular significance. According to this the laws of image formation by an optical system can be expressed through a single characteristic function, the Eikonal function. The remaining parts of the book deal with some of the rigorous laws of image formation, the third and fifth-order image-error theory and the methods of drawing and analysing "spot diagrams" which give a record of the distribution of light over selected image planes and are of great significance in lens design.

The mathematical methods, some of them new, which are used in the book are explained in the appendix in a way easily understandable to the practical designer. It contains a chapter on vector analysis and one dealing with matrices,

least squares, Gaussian brackets and polynomial approximations.

A numerical example of tracing of skew rays, astigmatism and asymmetry through simple lens in air, is given as the last chapter of the Appendix. The problem looks apparently easy, but a glance through the fourteen pages of the chapter shows the formidable amount of calculation involved (simplified though by electronic computers) with figures to several places of decimals, and the reader is left to wonder whether after all designing lenses is not more of an art than a science.

The book ends with an interesting historical chapter in which are mentioned the contributions to the science of geometrical optics by Rene Descartes, Huygens, Newton, Hamilton and Gullstrand. There is also an extensive bibliography.

From the students' point of view, the title may be somewhat misleading. It is not intended to be a text-book, but fulfils the special need of those who are interested in the problems of geometrical optics in general and in the design of lenses in particular.

A. S. G.

Philips Technical Library: (1) *Multivibrator Circuits*, by A. H. Bruinsma, 1959. Pp. 125. Price Rs. 5-00.; (2) *Practical Robot Circuits*, by A. H. Bruinsma, 1959. Pp. 125. Price Rs. 12-00. (India: Philips India Pvt. Ltd., Calcutta-20.)

The so-called multivibrator, in its simplest form, is a two-stage amplifier whose output is connected to the input and has several modifications. The output voltage of the multivibrator is a square wave whose width, amplitude and shape are controlled by the circuit elements. Sharp triggering pulses often called spike voltages can be derived by differentiating the square wave with an R.C. network. They have wide applications in fast electronic switching and pulse techniques. Among the variations of multivibrator circuits, monostable and bistable circuits have important applications. Much use is made of the latter circuit in binary electronic counting. The publication under review brings within its fold a practical discussion of the fundamentals of the so-called free running multivibrator and several of its modifications.

mentioned above. Use of pentodes in multivibrators is treated at some length. The reviewer warmly recommends this publication to those who are in search of a simple but precise introduction to multivibrator circuits.

The second publication under review is devoted to a description of two robot systems developed as demonstration models, the one resembling a dog capable of imitating to some extent its living counterpart when stimulated by an external agency, and another stationary robot capable of reasoning to the extent of playing the simple game of noughts and crosses. A double photoelectric cell with the associated circuits providing stereoscopic vision, stereophonic microphone circuit for hearing, and an acoustic radar system for sensing objects constitute the principal electronic organs of the robot animal. The electronic brain circuits incorporated interpret the stimuli received from these and order the action elements which are in this case motors to function as demanded by the situation. The concerned circuits and the fundamental principles of their operation are discussed with numerous illustrations. The mechanical aspects of the design of the robot are described. Under the title "Electronic Intelligence", the second mentioned robot is discussed. Starting with the analysis of the game, the chapter passes on to a description of the robot and how it plays the game. Since multivibrator circuits are made use of frequently in the two robots dealt with, the author's publication on 'Multivibrator Circuits' reviewed above would serve as a useful introduction. The book is highly interesting and will suggest to the seeking mind, numerous other applications of the circuits described.

A. J.

A Course of Pure Mathematics. Tenth Edition. By G. H. Hardy. (Cambridge University Press), 1958. Pp. xii + 509. Price 22 sh. 6 d. net.

A Course of Pure Mathematics by G. H. Hardy has established itself as a standard text-book for students of the honours level for a long time and is such a popular book that it hardly needs any introductory review. The present volume is a paper bound tenth edition of the book, the appearance of the first edition being in the year 1908. Much progress has been made in the subject since the book was first published and Analysis is now being steadily dominated by ideas of Measure Theory and Topology. The book, however, has a charm and vitality of its own and its usefulness

to University students still remains undiminished. The present edition of the book will be warmly welcomed by all.

V.

Potential Theory of Unsteady Supersonic Flow. By J. W. Miles. (Cambridge University Press, London N.W. 1), 1959. Pp. xii + 220. Price 45 sh.

The present monograph is one of the first attempts to survey the scattered literature that has grown during the last decade or so in the field of the application of the potential flow theory to the prediction of aerodynamic forces acting on thin wings and slender bodies in unsteady supersonic flight. The investigation of unsteady aerodynamic phenomena becomes increasingly important as we approach supersonic speeds. This monograph, therefore, will be specially valuable to those engaged in research in unsteady flow and to aerodynamicists concerned with stability and flutter problems.

After discussing the basic equations of unsteady potential flow in their exact and approximate forms, the author develops the available methods of solution and applies them to supersonic wings, slender bodies and wing-body combinations. The author has included in the present monograph the interesting non-linear form of the "Piston theory" for hypersonic problems developed by Lighthill in 1953.

Both harmonic as well as transient motions have been considered to illustrate the principles of unsteady aerodynamic phenomena.

The bibliography which contains over 300 references will be valuable to research workers.

S. DHAWAN.

Tube and Semiconductor Selection Guide, 1958-59. Second Revised Edition. Compiled by Th. J. Kroes. (Philips Technical Library.)

This volume lists together all electron tubes and semiconductor diodes and transistors available in the market, that fall within the Philips manufacturing range or which can be replaced by equivalent Philips types. All these are put into seven categories and dealt with in separate sections: tubes for radio receivers and amplifiers, cathode ray tubes, transmitting tubes, tubes for microwave equipment, industrial tubes, miscellaneous tubes and semiconductors. The sections follow a uniform pattern of presentation, comprising a table that gives information on direct or near equivalent of the types listed, a table of preferred types for varied functions, tables that group the tubes

according to their most important properties, a table for replacement purposes, a guide for replacement of obsolete types, data on tube bases and sockets and details of tube designation systems.

In addition to the commonly encountered tubes, there are listed a variety of special tubes in the various categories, such as tuning indicators, secondary emission tubes, radar and television tubes, flying spot scanners, image orthicons, ignitrons, photo-sensitive devices, radiation counters, thermocouples, trigger tubes, etc. The wide range covered is typical of the Philips organisation, which, by its scale of operations, ingenuity and skill, has become a world-leader in the design and construction and use of electron tubes.

The aim of this compilation is stated to be 'to enable the user of electron tubes to determine quickly which tube is to be preferred in the case in question'. This volume will admirably serve this purpose. It has an additional interest in this country, in view of the collaboration with Philips that has been set in motion, with the object of laying the foundation for the electron tube industry in India.

S. SAMPATH.

Antibiotics Annual 1958-59. Edited by Henry Welch, Ph.D. and Felix Marti-Ibanez, M.D. Medical Encyclopedia Ins., New York, N.Y. Distributed outside U.S.A., by Interscience Publishers Inc., New York, N. Y. Pp. xvii + 1107. Price \$12.00.

This is the record of the Proceedings of the Sixth Annual Symposium on Antibiotics held on October 15-17, 1958, in Washington, D.C. Though most of the 180 papers are from U.S.A., there are contributions from 14 other countries. We find one from Peru and we hope that soon there would be papers "from China to Peru" embracing the whole world where "antibiotics culture" is holding sway. The antibiotics dealt with are: penicillin V, spiramycin, tetracycline-oleandomycin combination, erythromycin propionate, ristocetin, leucomycin, triacetyloleandomycin, actinobolin, streptovitacin A and B, vancomycin, kanamycin, etc. The long acting sulphonamides, nitrofurans and quaternary compounds have also got into the company of the antibiotics. The two Panel Discussions "The current status of erythromycin, kanamycin, novobiocin, oleandomycin, ristocetin and vancomycin with particular reference to their use in staphylococcal diseases" and "Causation, prevention and control of staphylococcal diseases in hospitals" are of interest. The symposium

being held 30 years after the discovery by Fleming and 10 years after the broad spectrum antibiotics, there was an interesting historical session where some of the makers of the modern antibiotic era had their say in retrospect. These 44 pages constitute interesting reading. Marti-Ibanez rides the "winged Pegasus" himself in his characteristic vein and sets us thinking about "how antibiotics might have changed the course of history" had they been available to Henry VIII, Charles V and Lenin! Florey dispels "many myths and distortions" spun around penicillin. The reviewer cannot agree that his not patenting of the process of extraction of penicillin by the Oxford group was a "cardinal error". Waksman says the bitter truth about those who describe "each fresh culture...and a fresh isolate as a new species" that it is "scientifically inaccurate, logically unsound and hardly proper from any point of view". Keefer pleads for more fundamental researches; "the usefulness of useless knowledge must never be overlooked" is sound advice to those who cannot see beyond their noses. The words of Dowling "The history of the broad spectrum antibiotics reveals no single hero. It is the history of many men and women thinking together, planning together, working together, studying, communicating and achieving together" should be inscribed at the entrance of the Antibiotics Institutes.

The *Antibiotic Annual* has become an indispensable companion to all those interested in antibiotics.

K. GANAPATHI.

The Uterus. (*Annals of the New York Academy of Sciences*, Vol. 75), 1959. Pp. 385-1040. Price \$7.00.

Many facets of the physiology of uterus and endocrinology of reproductions still remain an enigma. The application of newer techniques and the concerted efforts of scientists of numerous disciplines, particularly the biochemists during the last two decades, while advancing our knowledge of human reproduction has posed many new problems. To obtain effective leads for further investigation, a reappraisal of the present status of our knowledge has now become essential.

This voluminous monograph on uterus dealing with such diverse topics as historical and morphogenetic considerations, biochemistry and histochemistry, problems in uterine tumours, blood coagulations in pregnancy, aspects of gravid uterus, uterine contractions, menstua-

tion and menstrual disorders, structural and functional aspects of the placenta and evaluation of non-steroidal ovarian hormones has admirably fulfilled this objective though in the limited field of uterine physiology.

The significant role of relaxin 'a non-steroidal ovarian hormone' in pregnancy and parturition, the influence of placental hormones on foetal development, Electrohysterography and the quantitative analysis of amniotic fluid in unravelling the nature of contractility in pregnant uterus, the complex and dynamic muscular, vascular and fluid mechanisms utilized by the gravid uterus, mechanism involved in the fibrinogenopenic accidents of pregnancy and delivery, the application of histochemical techniques for enzyme determinations of placenta and malignant endometria are some of the salient features lucidly discussed in this monograph.

M. SIRSI.

Some Aspects of Food Technology in India.

Edited by H. A. B. Parpia, R. C. Bhutiani, K. L. Radhakrishnan, A. N. Sankaran and B. V. Subbarayappa. (Central Food Technological Research Institute, Mysore-2), 1959. Pp. viii + 160.

The publication under review was brought out by the CFTRI, Mysore, on the occasion of the F.A.O. Regional Seminar on Food Technology for Asia and the Far East which was held at the Institute from August 1-8, 1959. It is essentially a compilation of the contributions made by the members of the CFTRI in the field of food science and technology and gives a broad survey of the results of investigations with which the Institute has been actively engaged in recent years. Among the topics presented in the publication are Rice Substitutes, Insect Infestation in Stored Foodstuffs, Fish Technology, Chemistry and Technology of Fruit Products, Dehydration of Vegetable and Animal Foods, Storage Techniques, Processed Protein Foods, Spices and Aromatics in Indian Dietary, Researches in Coffee and Tea.

The chief object of this publication is, as pointed out in the Prefatory note by the Director of the Institute, to bring to the notice of the delegates from other countries attending the Seminar certain aspects of scientific and technological work which if adequately developed would be of value to those countries which are similarly placed as India. There is no doubt that this informative monograph more than adequately fulfils the above object and it

will serve not only as a reference but also as a guide to those who have programmes of work to solve similar problems in food technology.

Developmental Cytology, Sixteenth Growth Symposium. Edited by Dortha Rudnick. (Ronald Press), 1959. Pp. v + 215. Price \$ 7.00.

The co-ordinated cellular differentiation in different directions during morphogenesis has intrigued biologists for several decades. It is not surprising, therefore, that the Sixteenth Symposium of the Society for the Study of Development and Growth is centred round the problem of Cellular Differentiation. The title of the volume, *Developmental Cytology* is, as the Editor seems to be aware, slightly misleading, since the papers presented discuss only certain aspects of differentiation in cell types like Paramoecia, Algæ, Fern prothallia, Cnidoblasts of Hydra, chlorophyll containing tissues of normal and etiolated plants, salivary glands of insects and malignant tissues of vertebrates and man. The cell organelles discussed range from nuclei and chromosomes to chloroplasts, mitochondria, endoplasmic reticula and microsomes. The possibility of a heteroploid transformation and a concomitant shift to malignancy of normal tissues when grown in culture, reported by Hsu, and the role of the nucleus as supplying the starter molecules for later amplification by the cytoplasm suggested by Stich are interesting.

The volume is attractively got up, but the lack of concordance between the text and the legend of Fig. 8 (p. 37) could have been avoided. The price of the volume is prohibitive for workers in India.

M. K. SUBRAMANIAM.

Books Received

Exploring the Structure of Matter. By Jean-Jacques Trillat. (George Allen & Unwin Ltd., 40, Museum Street, London W.C.1), 1959. Pp. 214. Price 30 sh.

A History of Embryology, Second Edition. By J. Needham. (Cambridge University Press, London N.W.1), 1959. Pp. 304. Price 52 sh. 6 d.

The Vertebrate Story. By A. S. Romer. (The University of Chicago Press, Chicago-37; Cambridge University Press, London N.W.1), 1959. Pp. vii + 437. Price 52 sh. 6 d.

Elements of Wave Mechanics. By N. F. Mott. (Cambridge University Press, London N.W.1), 1958. Pp. ix + 156. Price 15 sh.

- Elements of Solid State Theory.* By G. H. Wannier. (Cambridge University Press, London N.W. 1), 1959. Pp. vii + 270. Price 35 sh.
- The Clonal Selection Theory of Acquired Immunity.* By Sir M. Burnet. (Cambridge University Press, London N.W. 1), 1959. Pp. ix + 208. Price 22 sh. 6 d.
- Utilization of Nitrogen and its Compounds by Plants.* (Symposia of the Society for Experimental Biology, No. XIII.) (Cambridge University Press, London N.W. 1), 1959. Pp. vii + 385. Price 50 sh.
- The Temperature of British Fish during Distribution in Summer.* (Torry Research Station—Paper 1). By G. H. D. Burgess, R. M. Cockburn, C. L. Cutting and W. B. Bobb. (Department of Scientific and Industrial Research, 5-11, Regent Street, London S.W. 1), 1959. Pp. iv + 54. Price 3 sh. 6 d.
- Human Nutrition and Dietetics.* By Sir Stanley Davidson, A. P. Meiklejohn and R. Passmore. (E. & S. Livingstone Ltd., 16-17, Tevist Place, Edinburgh), 1959. Pp. xii + 844. Price 84 sh.
- Elementary Statistics with Applications in Medicine and the Biological Sciences.* By F. E. Croxton. (Dover Publications Inc., New York-15 N.Y.), 1959. Pp. vii + 376. Price \$1.95.
- Evolution of Nervous Control from Primitive Organisms to Man.* Edited by Allan D. Bass. (American Association for the Advancement of Science, Washington D.C.), 1959. Pp. vii + 231. Price \$5.75.
- Lectures in Applied Mathematics, Vol. 1. (Probability and Related Topics in Physical Sciences.)* By Mark Kac, G. E. Uhlenbeck, A. R. Hibbs and B. Vander Pol. (Interscience Pub., New York-1), 1959. Pp. xiii + 266. Price \$5.60.

SCIENCE NOTES AND NEWS

Central Botanical Laboratory, Allahabad

Dr. G. S. Puri succeeds Dr. E. K. Janaki Ammal as the Director of the Laboratory.

Award of Research Degree

The Annamalai University has awarded the Ph.D. Degree in Chemistry to Mr. R. Varadachari for his thesis entitled "Synthesis and Ultra-violet Absorption Spectra of Some Sulphoxides and Sulphones".

UNESCO Regional Training Courses

A regional training course on the use of Radioisotopes in agricultural research, organized jointly by the Ministry of Food and Agriculture, Government of India, FAO, International Atomic Energy Agency and UNESCO South Asia Science Co-operation Office, will be held at the Indian Agricultural Research Institute, New Delhi, from 20th January to 17th February 1960.

The syllabus of the course will deal with the role of radiation in cytology and genetics, radioisotope techniques as applied to problems in soil fertility, fertilizer application and plant biochemistry and radiation as a protective agent. A maximum of 25 participants will be admitted to the course.

A regional training course on 'High Vacuum Techniques', sponsored jointly by the National Physical Laboratory, New Delhi, and the

UNESCO South Asia Science Co-operation Office, will be held at the National Physical Laboratory, from 18th January to 12th February 1960.

The syllabus will relate especially to the developments in high vacuum techniques in science and industry during the last 20 years. The course will be directed by Prof. A. L. Reimann, Research Professor of Physics, University of Queensland, Brisbane (Australia), who will be assisted by Dr. J. H. Leck of Liverpool and members of the NPL staff (New Delhi). A maximum of 20 participants will be admitted.

Enquiries about the training courses should be addressed to the UNESCO South Asia Science Co-operation Office (SASCO), 21, Curzon Road, New Delhi, India, of the Indian National Commission for UNESCO, Ministry of Education, Government of India, New Delhi.

Improved Grain Storage Structure for Village Conditions

Messrs. S. Pradhan, P. B. Mookherjee and G. C. Sharma, Division of Entomology, Indian Agricultural Research Institute, New Delhi, write: It is the common practice in villages to store grains in earthen structures. However in this type of storage the grains are often found to be infested with insect pests. It is found that the storage effect is improved if the mud wall of the structure is built with a thin sheet

polythene sheet, thus inserted in the middle. The idea behind the sandwiching of the polythene film within the body of the wall is to enhance the mechanical strength of the material and also to make it more impervious to the passage of vapours and gases. It has thus helped keep the polythene film free from mechanical strains and abrasion injuries which would result if it is used as an outer or inner lining.

The above comparative observations show that the rice grains stored in the polythene-lined structure remained in excellent condition from July 1957 to April 1959, whereas the stored in the ordinary earthen structure for the same period was found to be 90% infested by *Callosobruchus oryzae*. In another trial with 23 samples of wheat each stored for the same period in the two structures, after one initial fumigation with carbon tetrachloride, the grain in the polythene storage remained in good condition, while that in the other was found infested over 16% by *Rhizopertha dominica*.

Also preliminary experiments have given indications that even when introduced, the four principal storage pests (*Callosobruchus oryzae*, *Rhizopertha dominica*, *Tribolium castaneum* and *Trogoderma granarium*) are not in a position to breed well in this improved type of storage structure. Studies on the moisture content of wheat showed that it was less in the polythene structure storage than in the other. These observations were carried out with wheat having an initial moisture content of about 10% which subsequently rose up to 13% in some cases.

Beneficiation of Minerals

The Golden Jubilee Symposium on the "Beneficiation of Minerals" was held in the Department of General Chemistry of the Indian Institute of Science, Bangalore, on 28-30 September, 1959. Mr. B. Rama Rao, Retired Director, Indian Bureau of Mines, inaugurating the symposium, surveyed the position of the mineral wealth in India and pointed out that the value of the mineral production, which was Rs. 7 to 8 crores in the early part of this century, had risen to more than Rs. 100 crores at present. Also the number of minerals mined has increased from half-a-dozen to more than 35. Mr. Rao then delivered his presidential address on "Beneficiation and Processing of Minerals with Special Reference to the Minerals of Mysore State".

Earlier Prof. M. R. A. Rao welcomed the delegates to the Symposium.

The subject-matter of the Symposium could

be broadly classified into (i) theory of grinding, (ii) flotation theory and practice with particular reference to sulphides, manganese ores, beach sands, gold tailings, uraniferous granite, (iii) heavy media and hydrocyclone methods in the beneficiation of pyrites and coals, (iv) phase separation methods for demineralisation of coals and graphites, (v) chemical methods including the theory and practice of chlorination and (vi) miscellaneous subjects including the methods of production of ferromanganese from ferruginous manganese ores, contact angle measurements in welding and microscopic petrography in beneficiation methods.

On the second day of the Symposium Dr. C. C. Patel gave a lecture on recent developments in the beneficiation of minerals by gravity, magnetic, electrostatic and flotation methods.

Bacterial Blight Disease of Rice

Messrs. M. C. Srinivasan, M. J. Thirumalachar and M. K. Patel of the Plant Pathology Laboratory, College of Agriculture, Poona-5, write:—

The bacterial blight disease of rice occurs in Bombay State on an extensive scale, often epiphytotic in restricted pockets. The disease causes considerable damage by inciting yellowing of the leaves and premature wilting. The plants are susceptible to infection at all stages of growth, depending upon the occurrence of predisposing conditions. The first stage of infection appears as a water-soaked, translucent streak on the leaf and leaf-sheath, 5-10 mm. in length. The streaks often coalesce with one another, appearing pallid white. Under humid weather conditions, bacterial exudate may be seen on the infection spot as tiny white encrustations.

The inciting organism is chiefly vascular. Attempts to isolate the bacterium in artificial culture on routine laboratory media were not successful and an enriched medium had to be devised for obtaining successful growth. Cultural studies have indicated that the organism is a strain of *Xanthomonas oryzae* (Uyeda & Ishiyama) Dowson which is of slow growing type.

Inoculation experiments were carried out to evaluate the resistance in important commercial rice varieties and wild species of *Oryza*. Thirty-two cultivated varieties and eight wild rice species were inoculated under favourable conditions and host reaction was studied at various periods. Observations have indicated that while most of the cultivated varieties and *Oryza* Spp. were highly susceptible, only two of them

BAM-9 and MTO-15 showed some degree of resistance.

Anthoceros punctatus in Bhopal

Sri. O. N. Handoo, Botany Department, Government Hamidia College, Bhopal, writes :—

A. punctatus Linn., a black-spored *Anthoceros*, grows commonly in hills of Delawari (Bhopal) in shade, somewhat sparsely, amidst grass, *Notothylas indica* Kash. and *Riccia billardieri* Mont. et N. It agrees closely with *A. crispulus* (Mont.) Douin but shows four tiers in the antheridial wall more distinctly. *A. crispulus* is a synonym of *A. punctatus*.

Previously this species was reported from Assam (Chopra, R. S., *Jour. Ind. Bot. Soc.*, 1943, 22, 239; Kachroo, P., *Sci. & Cult.*, 1952, 18, 284) and neighbourhood of Lucknow (Pande, S. K. and Bharadwaj, S. C., *Jour. Ind. Bot. Soc.*, 1949, 28, 15) and is new to Bhopal. It has not been collected from South India so far.

Effect of High Pressures on the Infra-Red Absorption of Calcite

Weir and his co-workers have studied the effect of pressures up to 30,000 atmospheres on the infra-red absorption spectra of calcite and other carbonates, with a specially constructed pressure cell using a pair of type-II diamonds as windows. Type-II diamond which combines high strength with excellent infra-red transmission in the range 1μ to 15μ (except for a strong absorption band near 5μ) is found to be a suitable window material for absorption studies under high pressure. The substance is taken in the form of a fine powder (and diluted, if necessary, with KBr or LiF) and placed between the two small diamond flats in the Bridgman pressure squeezer apparatus.

The results of detailed study show that under pressure, bands generally shift to higher frequencies and decrease in intensity. The magnitude of both changes depends on the mode of vibration. In calcite the carbon-oxygen symmetric stretching frequency ν_1 ($= 1097\text{ cm.}^{-1}$) which is a prominent frequency in the Raman effect but forbidden in the infra-red, becomes active at elevated pressures and also shows an increase in intensity as the pressure rises. The doubly degenerate, asymmetric stretching frequency ν_3 ($= 1463\text{ cm.}^{-1}$) splits into two components at 31,000 atm. showing a separation of 103 cm.^{-1} . This splitting is reversible and disappears when the pressure is lowered. The frequency ν_4 ($= 748\text{ cm.}^{-1}$) doubly degenerate, planar bending, also splits under pressure but this is less apparent. The ν_2 mode at 883 cm.^{-1}

is not degenerate and shows no tendency towards splitting.

In the case of calcite these observed results may be explained by a shift of the CO_3^{--} ion from the trigonal axis under pressure—*Jour. Research*, 1959, 63 A, p. 55.

Mirage and an Early Recorded Arctic Phenomenon

In an article on "The Optics of Mirages" which appeared in an earlier issue of this Journal (*Curr. Sci.*, August 1959) Sir C. V. Raman has shown that the usual explanation of mirages based on geometrical optics does not really solve the problem, but that a correct and complete elucidation of all the facts observed in the production of mirages involves a rigorous treatment based on the principles of the wave-theory of light. Accordingly he has developed a simple but elegant wave-optics theory which explains in a natural way not only the mirages but also many other features which arise in their formation.

The superior type of mirages mentioned in that article arise when the thermal conditions of the atmosphere are the reverse of those which give rise to the ordinary type, i.e., they are observed when the atmosphere rests on a cold level surface above which there lies a hot stratum of air. Objects at or near the level of the cold surface are usually visible to the observer, and in addition inverted images of them are also seen higher up in the atmosphere.

Apropos Raman's theory of mirages, the following observation of what is known as the "Novaya Zemlya Phenomenon" recorded by Gerrit de Veer, a Dutch Navigator, in 1598, will be of interest. We are indebted to the Royal Netherland Embassy in India for the information.

The story is of Willem Barentsz and his little band of sailor-adventurers who set forth in 1596 on an expedition to discover the North-East Passage across the Arctic. During the expedition the crew of Barentsz' ship was forced to pass the winter on Novaya Zemlya. Out of parts of their ice-bound ship they built a house where they lived during the long Arctic night. Barentsz himself died during the home voyage in 1597, but as early as the next year a printed account of the voyage appeared from the pen of Gerrit de Veer, one of Barentsz' companions.

"On 24 January, 1597", writes Gerrit de Veer, "it was faire cleare weather with a west wind. Then I and Jacob Hemskerche, and another with vs went to the sea-side on the south

side of Nova Zembla where, contrary to our expectation I the first of all saw the edge of the sun, which has not been visible since the 3rd of November, wherewith we went quickly home again to tell William Barents and the rest of our companions that joyfull news. But William Barents, being a wise and well experienced pilot, would not believe it, expecting it to be about fourteen daies too soon for the sunne to shyn in that part of the world, but we earnestly affirmed the contrary and said we had seene the sunne."

Further on in his account Gerrit de Veer reports three more occasions on which the sun was prematurely visible.

J. W. van Kouhays has recorded in 1918, a similar observation in the story of Shackleton's last expedition (1914-17).

Isotope Techniques in Water Survey

The circulation of water is one of the most interesting of natural phenomena. The broad outline of this process is well known. Evaporation of water on the sea-surface and the eventual precipitation of the vapour follow a complete cycle that sustains life on the earth. The working of the cycle, however, is not quite uniform; the rate of precipitation varies from one region to another.

At present, the pattern of circulation is known only in rough outline; detailed information on a global scale is lacking. One of the most effective ways of gathering such information is to study the isotopic ratios of hydrogen and oxygen in water in different areas. The ratios vary for rain, river and ocean-water, and the variation has a relationship with the rate at which water circulates in nature. Water contains two stable hydrogen isotopes and three stable oxygen isotopes. In addition, very small quantities of radioactive hydrogen or tritium are added from outer space or as a result of reactions in the atmosphere brought about by cosmic rays or as a result of the testing of thermonuclear weapons. Tritium can serve as a tracer in the study of water circulation.

A variety of information can be obtained by measurement of the isotopic composition of water. For example, by comparison of the tritium concentration of inflowing water with that of outflowing water, the average age of the water molecule in a lake can be deduced.

Again, tritium determinations can sometimes yield valuable information on the age of ground water and on the size of the ground water body.

Looking to the importance of such investigations, the International Atomic Energy Agency has decided to initiate a study to determine the world-wide distribution of hydrogen and oxygen isotopes in water. Under this project, it is proposed to collect samples of rain, river and ocean-water in different parts of the world and carry out measurements through a world-wide network of sampling stations. The measurements will be interpreted by qualified experts with the object of assisting different countries in the evaluation of local data and in estimating the conditions of present and future water-supplies. --IAEA Bulletin, October 1959.

Cobalt Irradiation Facility at the New Delhi Agricultural Fair

An operating cobalt irradiation facility will be a feature of the U.S. Atomic Energy Exhibit at *Amriki Mela* in the World Agriculture Fair, which opens on December 11, 1959, in New Delhi. The pool-type irradiator will employ a 5,000 curie radiocobalt source, shielded by 14' of water. The radiation area is segmented so that any degree of exposure required is available within the limits of the source itself. Throughout the Fair, the facility will be used to irradiate seeds, plant cuttings, food and insects, as well as materials sent in by scientists elsewhere in India and South East Asia. Materials sent in will be irradiated free of charge and returned promptly by mail, a service which will serve as a considerable stimulus to atomic energy research in the area.

The radiation laboratory will be staffed by both Indian and American scientists, who will co-operate on research projects developed in collaboration with the Indian Agricultural Research Institute and the Indian Atomic Energy Establishment. An interesting feature of the laboratory, from the standpoint of the lay audience, will be the eerie blue Cerenkov glow which will emanate from the depths of the pool and will be clearly visible in the specially-lighted exhibition chamber. Material that Indian Researchers wish to be irradiated should be sent to the Indian Agricultural Research Institute at Pusa, New Delhi.

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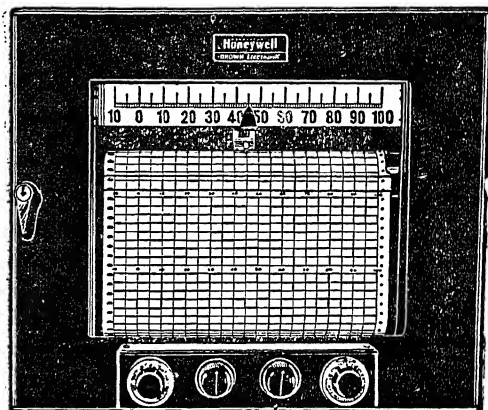
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NIGHTGLOW AND TWILIGHT IN THE ANTARCTIC*

INTRODUCTION

DR. ANTONIN MRKOS, the author of this article, is a member of the scientific group for the high atmosphere studies at the Czechoslovak Academy of Sciences and participated in the third Soviet Antarctic Expedition (1957-58) organized within the IGY research activities. Dr. Mrkos carried out his observation of the night sky at the Antarctic Observatory Mirny and also aboard the vessels Kooperatzia and Ob sailing across the Indian and Atlantic oceans in the regions between the two polar circles. The scientific programme planned out for his study dealt chiefly with researches of the high atmosphere by indirect methods. These comprised: (1) photoelectric measurements of the nightglow, (2) photoelectric measurements of the twilight and dawn, (3) observing, measuring and photographing of auroras, (4) photographing of auroral spectra, (5) observing of telescopic meteors, (6) observing of noctilucent clouds and noctilucent bands.

coast of the Davis Sea (Fig. 1). The position of the instrumentation was $66^{\circ} 33' \text{S.}$ and $93^{\circ} 01' \text{E.}$ The house was electrically heated which permitted the equipment to be kept at a relatively constant temperature and also enabled work to be continued even during severe frosts and winds. The time accuracy of the observation was ensured by a chronometer as well as by a radio receiver which received the time signals from Washington, Tokyo and Honolulu. Anode batteries were used as source for the photoelectric multiplier FEU-17. The deflections were read on the Interflex mirror galvanometer. Measurements were made every hour both on bright nights and on moonless nights. The intensities of individual emissions transmitted by the interference filters were measured by substitution with an electric light source connected to the Wheatstone bridge. The conditions of measurements as well as the weather were more favourable in Mirny than in Central Europe. Between February 24 and October 12,

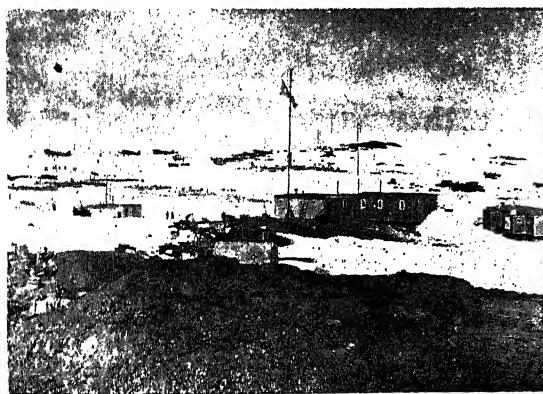


FIG. 1. The Mirny Observatory. In the background are the airfield and broadcasting station.

INSTRUMENTS AND METHOD

The measurements of the nightglow were made with a photoelectric photometer in four spectral ranges determined by the four Schott-Jena interference filters giving maximum transmission near wavelengths 5300 \AA , 5577 \AA , 5894 \AA and 6300 \AA respectively. The range of transmission about these maxima was 60-100 \AA . The measurements were carried out exclusively in zenith. The instruments were installed in a small wooden house situated northerly from the Mirny Observatory on the cape Chmara on the



FIG. 2. *Aurora borealis* over Mirny (its most frequent form).

1958, a total of 134 night measurements were effected. Further, 30 night measurements were carried out aboard the ships.

From the end of April 1958, a systematic recording of the green emission of the nightglow at 5577 \AA was made at intervals between the measurements. The recording was done by means of an electronic potentiometer EPP-09, with a sensitivity of 1 mV for the total range and record speed of 120 mm./hour, connected to the output of an electronic photometer. To further elucidate the information on the auroras, this recording was conducted also on nights with overcast sky and on clear moon nights. Experience showed that in Antarctica on moonless

* Through the courtesy of the Consulate-General of the Czechoslovak Republic, Bombay, India.

nights a full cloudiness—type cirrostratus, altostratus and altocumulus—does not prevent the recording of very weak auroras which otherwise would pass unobserved because of the cloudiness.

SUMMARY OF RESULTS ON NIGHTGLOW INTENSITIES

1. The observed intensities of the nightglow varied abruptly from night to night, the variations being sometimes as great as 100%. The two oxygen emission lines 5577 Å and 6300 Å showed, at their abrupt fluctuations in brightness, a systematic decrease of intensity which was observable up to the end of June. This was followed by a moderate increase in brightness and subsequently a systematic decrease recorded up to the middle of October when the measurements were closed. The systematic decrease in intensity of the green emission during the Antarctic night 1958 corresponded relatively well with the decrease of the absolute ozone contents in the atmosphere during the same period. These abrupt fluctuations in intensity of both the emissions are likely to be caused by the activity of weak, visually unobservable auroras.

2. During a night, often several maxima and minima were recorded at individual emissions. A very striking minimum of the green emission 5577 Å took place close to the dawn. The evening decrease in intensity of the green emission 5577 Å was by far more abrupt than that in the red emission 6300 Å which, on the other hand, began to increase in the morning 1-2 hours before the onset of the astronomical dawn.

3. A violent decrease, often below the night average, of both emissional regions 5577 Å and 6300 Å occurred also immediately after the passing of bright auroral forms through the measured point of the sky, when the aurora lower down on the sky was still very active. This decrease was more pronounced in the region 5577 Å than in the region 6300 Å. Such local decrease in intensity of the nightglow emission has not been observed in middle latitudes.

4. In the integral nightglow a considerable increase in intensity with the geographical latitude was recorded in 1957. The average intensity of the nightglow in Mirny towards the end of February 1958 was three times as great as that in the tropical region at the position 20° 34' S and 57° 13' E. When these measurements were repeated in 1959, during the trip aboard the ship Ob between 70° S and 54° N, such a striking decrease of the nightglow towards the Equator was not recorded. In 1959

the nights in the equatorial region were far brighter than those towards the end of 1957 and at the beginning of 1958 when, for example, the *Gegenschein* could be observed every night. In spite of the same astronomic observational conditions this phenomenon was never recorded in 1959.

5. The relative increase of the red emission at 6300 Å before the start of, during and after the auroral displays, was far feeble in the latitude of Mirny than in middle latitudes. The time intervals between the onset of the increase of the emission before the aurora and the decrease after the aurora were far shorter.

TELESCOPIC METEORS

A systematic study of the telescopic meteors, up to the limit magnitude of 9^m, on every clear moonless night proved that during the Antarctic night 1958, the hour frequency of the meteors in a given instrumentation was twice as low in Antarctica as in Central Europe.

The influence of this frequency on the emission intensity of sodium 5894 Å was studied and it was noted that on nights with increased intensity of telescopic meteors the absolute emission intensity of 5894 Å also increased. A similar increase of sodium emission was also observed during the nights when noctilucent bands occurred on the sky.

The results of the systematic recording of the variations in intensity of the green emission 5577 Å during the auroral displays (Fig. 2) were compared with the records of the variations of all components of the geomagnetic field, telluric streams and ionosphere vertical soundings. It appeared that (1) in the period of intensive outbursts of the green emission at 5577 Å, the vertical ionograms showed a diffuse reflection occurring at the heights of 150-180 km. It is the sporadic E layer of a or q type. (2) The large variations of all components of the telluric stream corresponded exactly both in time and in relative changes with the fluctuations in intensity of the recorded green emission 5577 Å. (3) The same correlation has been noted in the records of the variations of the geomagnetic field in almost all components. The above correlations were maximum in case of the auroras passing through the magnetic zenith and far feeble when the auroral displays were located at a distance of more than 20° from the magnetic zenith.

TWILIGHTS

131 twilights were measured in Mirny. The measurements of the twilight started usually on the solar depression of 5° and terminated

on the depression of 18° . The analysis of these measurements has not been made as yet.

During the measurements of the twilight, a phenomenon of particular interest was recorded. Nearly every day, before the end of the astronomical twilight, from the solar depression of 14° up, weak-rayed auroral display took place on almost the same spot of the sky showing South-North direction in the evening and East-West direction in the morning. In the evening the brightest rays usually passed through the point located at a distance of about 8° WNW from the zenith. The brightness of these auroral displays was mostly very faint and, without photometric measurements, unobservable. These auroras persisted usually for more than 1-2 hours at the end of the astronomical twilight. From the middle of March to the end of June the start of these auroras progressed by 5 hours in the evening whereas in the morning it delayed by 4 hours. No effect of these auroral displays on the recording of the geomagnetic field and telluric streams has been recorded. From the temporal variation in the start of these auroras in the course of the year as well as from their form and colour it may be concluded that these are special types of auroras appearing mostly during the daytime and caused by other processes of solar activity than those which cause the nocturnal auroras which have a steady maximum in Mirny at about 18 hours UT.

NOCTILUCENT CLOUDS AND BANDS

The noctilucent clouds were observed twice during the period of study in Mirny. For the first time they appeared on 28th March 1958 at 13 hr. 35 min. UT, showing considerable motion in ESE direction. Their estimated height was 82 km., and the real velocity of these clouds was 350 km./hour. The same day, a strato-

spheric jet-stream in the same direction and of the same velocity was measured by the aerometeorological group of Prof. Bugajev in Mirny. For the second time, the noctilucent clouds were observed on 13th May 1958 at 11 hr. 30 min. UT in zenith, being this time nearly stationary, with only a slow motion to SSW. In other respects, these noctilucent clouds did neither in colour nor in form differ from those observed in Central Europe.

On several nights, the noctilucent bands were observed in Mirny during 1958. They were usually brighter than those in Central Europe and were radially disposed on the sky with the radiation points from N to ES. The region of their maximum frequency in Mirny was that of SE. The noctilucent bands were observed also during the author's trips aboard Kooperatzia and Ob. Their first appearance in the southern hemisphere was recorded at 37° S. They were never observed in the tropical region.

CONCLUSION

The measurements of the instrumentation, filters and photomultipliers were conducted in the Astronomical Institute of the Czechoslovak Academy of Sciences and the measured intensities of the nightglow have been converted into absolute rayleigh units. By the end of this year, the values of the green emission 5577 \AA are to be analysed and forwarded to the corresponding World Centres. Thanks to the support of the geophysic group III, SAE, the author's instrumentation was amplified by the spectrograph SP-47 1:1 with a dispersion of 200 \AA/mm. and by the recording electronic potentiometer EPP-09. The chief of this group also permitted the use of the records of the vertical ionosphere soundings, telluric streams and variations of the geomagnetic field.

DEFENCE ELECTRONICS CONVENTION

A DEFENCE Electronics Convention, first of its kind in the country, was held in Bangalore from September 28 to October 1, 1959. Over 350 delegates representing 42 different major organisations got together for an intensive three-day discussion and interchange of views on the applications of electronics to Defence needs. Coinciding with the Convention, an electronics exhibition was also organised.

Inaugurating the Convention, Major-General B. D. Kapur stressed upon the growing application of electronics to the Defence equipment and the need to evolve our own standards for evaluation of equipments suited to Indian conditions.

Over 40 significant papers were read and discussed during the technical sessions, ranging from problems in Development and Production of Electronic Equipment, Effects of Environmental Hazards on Electronic Equipment, Guidance and Control Systems, Automation, Instrumentation, Reliability Problems, and Education and Training of Electronic Engineers.

Highlights of the whole programme were two talks one by Sir C. V. Raman on 'Infra-Red Radiation' and the other by Major-General B. D. Kapur on 'Career Prospects for Scientific and Technical Personnel in the Ministry of Defence'. Prof. M. S. Thacker delivered the Distinguished Guest Speaker's Address.

BIOGENESIS OF NATURALLY OCCURRING TETRONIC ACID DERIVATIVES

S. NEELAKANTAN AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-8

DERIVATIVES of tetronic acid (I) have been recognised as metabolic products of moulds belonging to the groups of *Penicillia* and *Aspergilli*. A number of them have been isolated by Raistrick¹ and his collaborators and their structures established and a few of them confirmed by synthesis. They are tabulated in Table I.

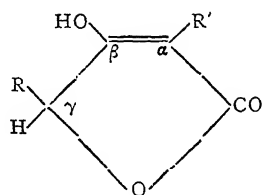
TABLE I

Compound	Sources
γ -Methyltetronic acid ² (II) ..	<i>Penicillium charlesii</i>
Carolic acid ^{3,4} (III) ..	do.
Carolinic acid ^{3,4} (IV) ..	do.
Carlosic acid ³ (V) ..	do.
Carlic acid ^{3,5} (VI) ..	do.
Terrestrial acid ⁶ (VII) ..	<i>P. terrestre</i>
Dehydrocarolic acid ⁷ (VIII) ..	<i>P. cinerascens</i>
Penicillic acid ⁸⁻¹⁰ (IX) ..	<i>P. puberulum</i> , <i>P. cyclopium</i> , <i>P. thomii</i> , <i>P. suavisolens</i> , <i>Aspergillus ochraceus</i>
L-(+) Ascorbic acid ¹¹ (X) ..	<i>A. niger</i>

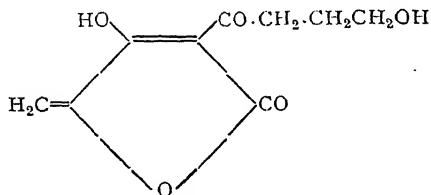
For the sake of convenience, compounds III, VI, VII, and VIII are here represented in the hydrated form with only one ring, though they are known to occur only in the anhydrous form having a second ring involving the acidic hydroxyl group in the β -position and that present in the side chain, e.g., VIIIa for compound VIII. Of these, the first seven compounds (II to VIII) form a closely related group and the other two appear to have different origin.

ASCORBIC ACID

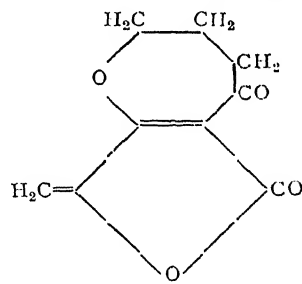
L-(+) Ascorbic acid (X) (vitamin C) has been known to be widely occurring as a product of higher plants also. Its structure (X) is closely related to hexoses and hence it may have a direct biogenetic relation to carbohydrates. Suggestion was made by Rangaswami and Seshadri¹² that the biogenesis of L-ascorbic acid (X) from D-glucose (XI) may involve the following changes. D-glucose (XI) was considered to undergo easy conversion into D-fructose (XII) which, by epimerization at C₂, may lead to L-sorbose (XIII); the subsequent



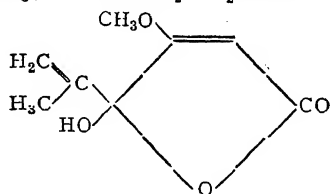
I, R=R'=H

II, R=CH₃; R'=HIII, R=CH₃; R'=CO·CH₂·CH₂·CH₂OHIV, R=CH₃; R'=CO·CH₂·CH₂COOHV, R=CH₂·COOH; R'=CO·CH₂·CH₂·CH₃VI, R=CH₂·COOH; R'=CO·CH₂·CH₂·CH₂OHVII, R=CH₃; R'=CO·CH₂·CH₂·CHOH·C₂H₅

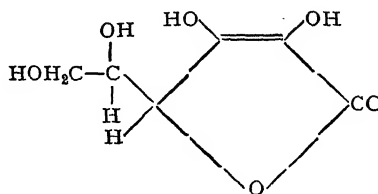
VIII



VIIIa

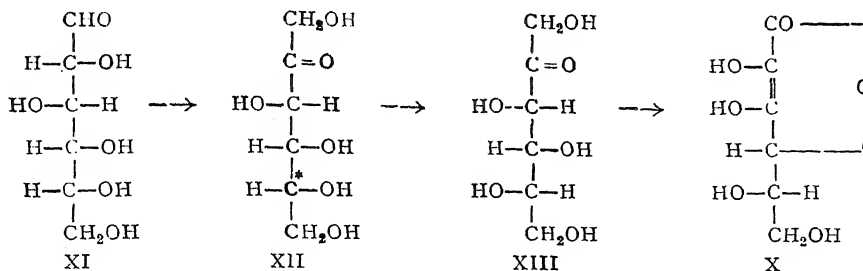


IX



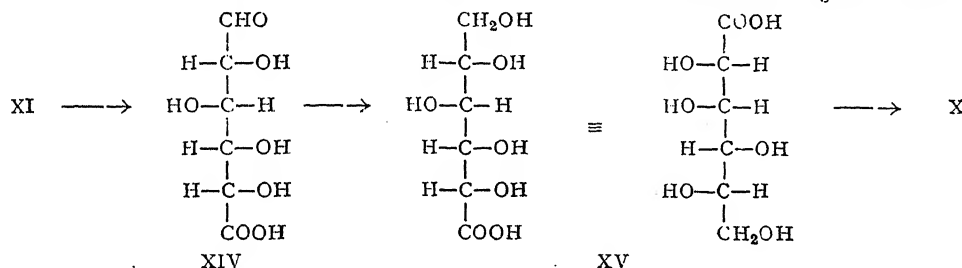
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steps were analogous to those well known in laboratory synthesis.

Horowitz *et al.*¹³ found that the radioactivity (C^{14}) of the aldehyde carbon atom of D-glucose (XI) was noted in the sixth carbon atom of L-ascorbic acid (X). Based on this, Isherwood *et al.*¹⁴ suggested that D-glucose (XI) undergoes oxidation to D-glucuronic acid (XIV) which, by reduction, forms L-gulonic acid (XV), subsequently oxidised to L-ascorbic acid (X).



However, recently Loewus and Jang^{15,16} proved that the observation of Horowitz *et al.*¹³ was wrong and found that the pathway of D-glucose (XI) to L-ascorbic acid (X) proceeded without cleavage and that the aldehydic carbon atom (C^{14}) of D-glucose formed the carboxyl carbon of L-ascorbic acid. In the light of these findings, the original suggestion of Rangaswami and Seshadri¹² may appear to be more valid.

PENICILLIC ACID

Birch and his co-workers¹⁷ studied the biosynthesis of penicillic acid (IX). They first considered that it had a terpene origin but tracer studies with mevalonic acid lactone did not support this. However, labelled acetic acid ($\text{CH}_3\text{C}^{14}\text{OOH}$) was incorporated in the biosynthetic penicillic acid and the activity was noted in carbon atoms 1, 3 and 5. In order to explain this, they suggested 5-hydroxyeverninic acid (XVI) as the precursor of penicillic acid (IX). Compound (XVI) was considered to undergo oxidative ring fission to (XVII) which on subsequent ring closure as well as decarboxylation would give penicillic acid (IX). This scheme is chemically acceptable. As a probable mechanism for this type of ring fission, it is now

suggested that it involves α -hydroxylation of the ketonic form (XVIII) of 5-hydroxyeverninic acid (XVI) followed by hydrolysis. It is known that reagents like Fenton's, which are analogous to enzyme systems, can bring about such α -hydroxylations.¹⁸ Ring fission of aromatic compounds in the evolution of natural products seems to be fairly common (*e.g.*, patulin¹⁹).

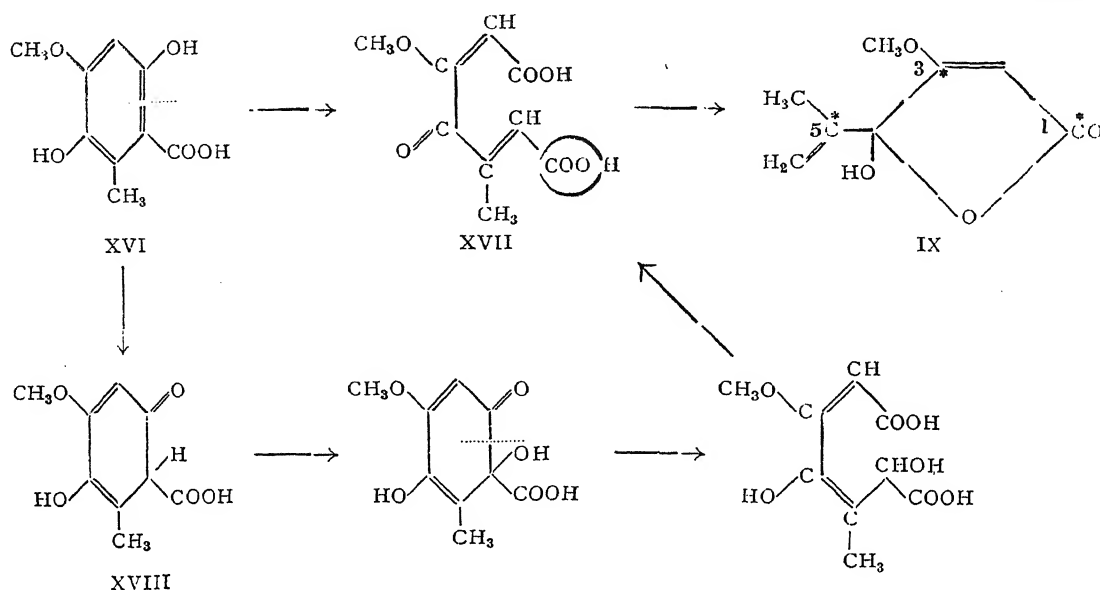
The above-mentioned C_8 -unit origin of peni-

cillic acid receives support from the fact that the concerned moulds, *Penicillium puberulum* and *P. cyclopium* are also known to produce compounds like puberulic and puberulonic acids²⁰ (tropolone derivatives) as well as cyclopolic and cyclopaldic acids²¹ (benzenoid derivatives) respectively which are all derived from C_8 -units.^{22,23}

γ -METHYLTETRONIC ACID GROUP

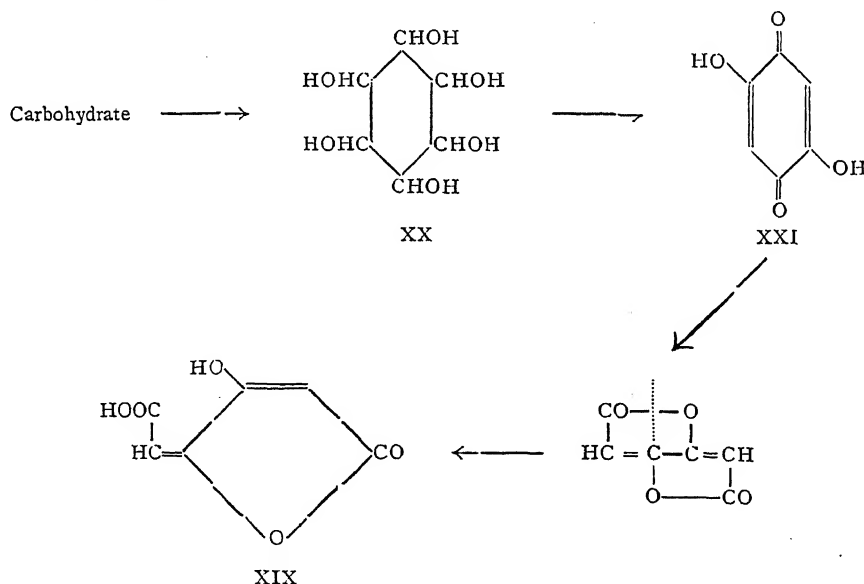
As mentioned earlier, the first seven members (see Table I) form a related group. Among them, the simplest would be γ -methyltetronic acid (II) and the others would arise by a further stage of substitution in the reactive α -position. The occurrence of dehydrocarolic acid (VIII) which has a methylene group in the γ -position would suggest that the common intermediate could be the carboxymethylene derivative (XIX) from which all other members may arise by feasible transformations.

The C_8 -unit (orsellinic unit) appears to be unsuitable as a precursor for these tetronic acids. Similarly it is difficult to derive them directly from carbohydrates. In this connection should be mentioned the recent work of Lybing and Reio²⁴ on the biosynthesis of carolic acid (III)



and carlosic acid (V). Their results indicate (i) that the acetate theory is not fully applicable to these acids and (ii) that the molecules consist of two portions, a 6-carbon chain of β -ketonic acid type and a 4-carbon chain which probably arises from carbohydrates.

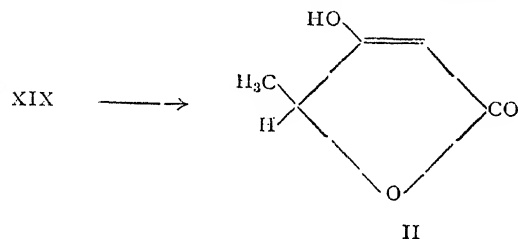
may be considered as the appropriate starting point for the evolution of many of the tetronic acids. This compound (XXI) can undergo oxidative ring opening similar to what has been suggested by Mittal and Seshadri²⁶ for the formation of pulvinic acid derivatives from



Based on the above considerations, the following suggestion that they have their origin in hydroxybenzoquinones is now made. In an earlier paper in this series,²⁵ it has been pointed out that inositol (XX) is most probably the precursor for the simpler hydroxybenzoquinone derivatives. 2 : 5-Dihydroxybenzoquinone (XXI)

polyporic acid series. Laboratory analogies for this type of ring fission are known. For example, polyporic acid is oxidised to pulvinic lactone by lead tetra-acetate.²⁷ As mentioned earlier, γ -carboxymethylenetetronic acid (XIX), which can arise from the above ring fission, may be the common intermediate.

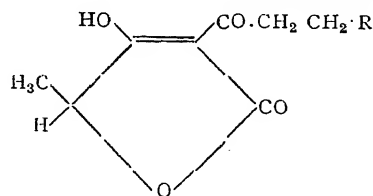
γ -Methyltetronic acid (II) can be formed from (XIX) by stages involving decarboxylation and reduction of the exocyclic double bond. Carolic acid (III), carolinic acid (IV) and terrestric acid (VII) have side-chains in the α -position of the above γ -methyltetronic acid (II) unit. It is easy to conceive that they arise by substitution in the reactive α -position.



carlosic acid (V) and carlic acid (VI). Dehydrocarolic acid (VIII) would require a slightly different intermediate (XXIII) which is the product of decarboxylation of (XIX) without reduction. This is followed by α -substitution by a 4-carbon chain.

SUMMARY

Tetronic acids so far known as mould pro-

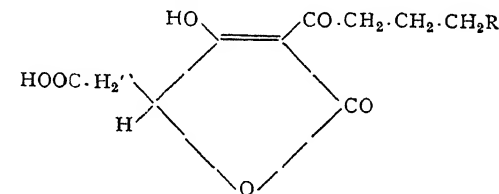
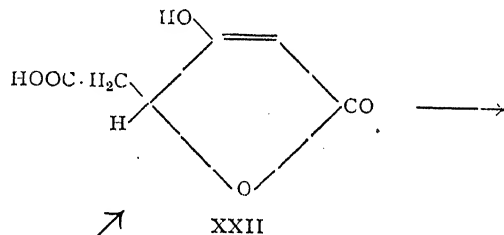


III, R=CH₂OH

IV, R=COOH

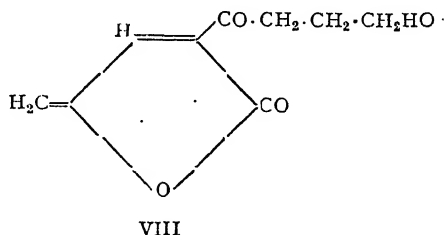
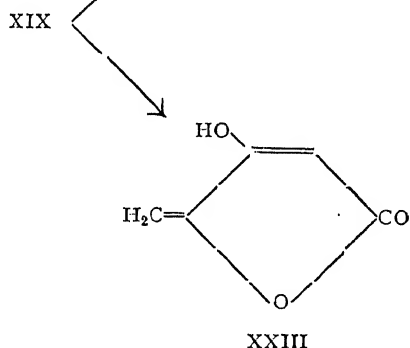
VII, R=CHOH.C₂H₅

In the case of compounds (III) and (IV), a 4-carbon unit (e.g., tetrose) is involved and in (VII), it is a 6-carbon unit (e.g., hexose). Subsequent oxidation reduction in the side-chain would lead to the required modifications (III, IV and VII).



V, R=H

VI, R=OH



A similar course could be suggested for the evolution of carlosic acid (V) and carlic acid (VI). For these, the appropriate earlier stage would be the intermediate γ -carboxymethyltetronic acid (XXII) which can arise from γ -carboxymethylenetetronic acid (XIX) by reduction without decarboxylation. Subsequent α -substitution by a 4-carbon unit would give

ducts seem to fall into three categories: (1) Ascorbic acid type arising directly from sugars; (2) penicillic acid type arising from C₈- (orsellinic) unit and (3) γ -methyltetronic acid type derived from dihydroxybenzoquinone and eventually from inositol.

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NEW LIGHT ON THE PINEAL GLAND

THE Pineal gland, the seventeenth-century philosophers' 'seat of the soul', long believed to have no biological function, is now thought to have important secretory functions. Recent investigations show that there are four neuro-humoral substances in bovine pineal gland; serotonin. (5 H, 5 hydroxytryptamine), nor-epinephrine, histamine and acetylcholine. A fifth pineal hormone, melatonin, very recently isolated, is an antagonist of the pituitary's melanocyte-stimulating hormone and is biologically active as a skin lightening agent. These findings appear to refute the belief in the pineal's lack of function. It also has all the morphological attributes of a secretory gland,

having a rich vascular and neural network. It contains as much serotonin and histamine as other parts of the brain, and half its acetylcholine level. It also contains the enzymes required for both synthesis and destruction of serotonin and related amines, and it picks up more P^{32} than any other tissues, whilst its I^{131} uptake is second only to the thyroid itself. A new adrenotrophic hormone has been isolated and identified as glomerulotrophin (GTH), probably a lipid since it is soluble in the fat solvent hexane. It is suggested that the pineal gland represents an atrophied immature pituitary which in primitive life controlled homeostasis.

BOMBAY UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY

THE University of Bombay will be celebrating shortly the Silver Jubilee of its Department of Chemical Technology. The Prime Minister, Shri Jawaharlal Nehru, is expected to inaugurate the celebrations on January 3, 1960.

The Department was started in 1934 for the admission of 20 students to a two-year degree course for the B.Sc. Tech. in Textile Chemistry and Chemical Engineering following the degree of B.Sc. in Chemistry. The late Dr. R. B. Forster of Leeds University was the first Head of the Department. Under the leadership of Professor K. Venkataraman, who was Director during 1938-57, further courses were added in 1943 in the Technology of Pharmaceuticals and Fine Chemicals; Food Technology (initially Chemistry of Foods and Drugs); Technology of Intermediates and Dyes; Technology of Oils, Fats and Waxes; and Technology of Plastics,

Paints and Varnishes—later changed into two separate courses: Technology of Plastics and Technology of Pigments, Paints and Varnishes. A four-year course in Chemical Engineering for the degree of B.Chem.Eng. which replaced the B.Sc. (Tech.) course was instituted in 1951. A three-year course in Pharmacy for the degree of B.Pharm. was instituted in 1958. In addition to its normal academic functions of teaching and research, the Department helps industries by carrying out research and analyses on their behalf.

The Department has, since its inception, made commendable progress. The total number of students has risen from 20 in 1934 to over 500 in 1959 and the teaching staff from 6 to 37. Over 1,500 students have so far graduated in Technology and some 300 students have received research degrees.

THE ANTIGENICITY OF DOLICHOS ENATION MOSAIC VIRUS

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A VECTORLESS, sap transmissible virus disease of *Dolichos lablab* L. was reported from Poona.¹ Subsequently this disease was noticed in Mysore and Madras States. The disease shows marked reduction of leaf blade caused by the suppression of growth in the interveinal areas, with the characteristic enations appearing on the lower side of leaves. These authors discussed the affinities of Dolichos enation mosaic virus (DEM V) and suggested that it resembled tobacco mosaic virus (TMV) in physical properties, Bean mosaic viruses 4 and 4A in thermal inactivation and Pea streak virus in dilution end-point. By cross-protection tests in White Burley tobacco evidence was obtained that DEMV was not related to TMV² and was confirmed here by preliminary serological tests with TMV antiserum.

An attempt to test DEMV for its antigenic properties was, therefore, made and is reported here.

Seeds of *Dolichos lablab* (variety DL 231) which were kindly supplied by The Millet and Pulses Specialist, Agricultural College, Coimbatore, were raised in ordinary garden soil in earthen pots, with 1-2 seeds. The plants were kept in a well illuminated greenhouse, with temperature around 30° C. Plants were kept in insect-free conditions through rigid nicotine spraying twice a week. The primary leaves of plants were inoculated with standard extract (a known fresh weight of infected leaves mixed with an equal volume of water, i.e., g. of leaf + 1 ml. of distilled water), using an abrasive 'Celite'. The leaves were sap-inoculated in the usual manner.

Precipitin reaction was carried out in short thick-walled tubes, half-immersed in a water-bath held at 37° C. for over a period of 1 hour. All serological reactions were carried out with 85% saline for dilutions.

Fresh leaves of systemically infected *Dolichos lablab* plants 15-20 days after inoculation, with

leaves showing prominent mosaic symptoms, were collected and standard extract prepared. About 6-8 ml. of infective sap, in a thin-walled test-tube was heated for 10 min. in a water-bath maintained at 60° C. and the sap cooled immediately in cold water, thus ridding sap of plant proteins which was centrifuged for 15-20 min. at 3,000-3,500 r.p.m. The clear brown supernatant was dialysed against running tap-water for over an hour, the sap again centrifuged for 15 min. The pH of this clarified infective sap was around 5.7 and was used for immunizing rabbits. An aliquot of the same was inoculated against *Nicotiana glutinosa* and *Dolichos lablab* to test for possible TMV contamination.

A course of six intravenous injections of 1-3 ml. of the clarified infective sap at intervals of 3 days were given to an 'Albino rabbit'. The animal was bled ten days after the last injection and the blood centrifuged for 30 min. at 3,500 r.p.m. to give a clear antiserum.

The antiserum was tested against both healthy and diseased *D. lablab* sap to ascertain specificity of antiserum to DEMV. While a negative result was obtained with healthy plant sap, there was a clear specific positive precipitate in reaction to infected sap. The amount of antibodies present in antiserum to DEMV was then estimated. A two series dilution of antiserum, with a factor of five, was prepared using saline, one of the series forming saline control mixture. At a known dilution of standard extract of antigen (DEM V) at 1/5 and recording the time of precipitation in precipitin reaction, over a period of 30 min. it was possible to obtain a high titre value of 1/625, as shown in Table I. Antiserum of DEMV gives a dense granular precipitate suggesting that DEMV is likely to be a spherical particle.^{3,4} A negative result was obtained when antiserum of DEMV was tested with TMV, suggesting that the two viruses are serologically not related. Antiserum

TABLE I
Showing titre value of antiserum to DEMV

	Antiserum to DEMV									
	1/1	1/5	1/25	1/125	1/625	1/1	1/5	1/25	1/125	1/625
Dilution of DEMV 1/5	++	++	-	-	-	-	-	-	-	-
	+++	+++	++	+	+	-	-	-	-	-
	++	+	+	-	-	-	-	-	-	-
	++++	+++	++	++	++	-	-	-	-	-
	+++	++	++	+	+	-	-	-	-	-

+ : relative amount of antigen.

* after 1 hour incubation.

to DEMV was mixed with an equal volume of glycerol (i.e., 50%) and stored in narrow mouthed glass-stoppered dustproof bottles at -4°C . for future use.

I thank Prof. T. S. Sadasivan for discussions. It is a pleasure to also thank my colleague Mr. A. Ramadas for assistance.

I thank the National Institute of Sciences of

India for award of a Senior Fellowship during the tenure of which this work was carried out.

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PHYSICS OF THE SOLID STATE

THE International Summer School on Physics of the Solid State was held at the Cavendish Laboratory of the University of Cambridge from 15th July to 13th August, 1959, under the Directorship of Professor N. F. Mott, F.R.S. Over 80 members were selected to attend the School of whom about 60 came from different countries. The School was financed by the funds of the Ford Foundation which also provided the travelling grants to many members of the School.

The subjects, covered by the course, could be divided under the following general headings: introductory lectures, theory of dislocations and point defects, chemical methods of observing dislocations, observation of dislocations by electron microscopy, applications of dislocation theory, contrast effects on electron micrographs of crystalline materials, electron and X-ray microscope techniques, colour centres in ionic crystals and mechanical properties of ionic crystals, defects in crystalline polymers, growth of crystals from the melt, and numerical calculations on dislocations and point defects. Seven visiting scientists and thirteen members of the University of Cambridge, delivered the courses of lectures.

Arrangements were made to set up, under the direction of group supervisors, study sections consisting of about twelve members to clear up difficulties arising with the academic side of the course. On three or four days a week, the afternoon sessions were mainly devoted to demonstrations, visits to laboratories and discussion of group meetings.

The introductory lectures on dislocations were given by Professor N. F. Mott. Dr. J. W. Mitchell (Bristol) gave the details for observing the dislocations by chemical methods. A series of lectures on the theory of defects and dislocations in Solids, was delivered by Dr. J. Fridel (Paris). Dr. M. J. Whelan (Cambridge) explained the principles of electron diffraction by crystalline materials and their applications in

the interpretation of contrast effects on electron micrographs of crystals.

After outlining the techniques of electron and X-ray microscopy, recent advances in the design and construction of electron microscopes which have enabled details below 10 AU to be resolved, were explained. The use of replica techniques in the study of metal specimens with the electron microscope was illustrated with a description on the methods of preparation of replicas. Dr. P. B. Hirsch (Cambridge) dealt with the low temperature plastic properties of face centred cubic crystals and the observation of dislocation in thin films. Dr. A. Kelly (Cambridge) described the types of precipitation found in Aluminium and Copper with an account of X-ray and magnetic methods used to study the process of deformation in the interior of crystals. Current theories of the interaction of dislocations, with coherent precipitates were advanced. Dr. P. L. Pratt (Birmingham) spoke about the mechanical properties of ionic crystals.

Professor A. H. Cottrell (Cambridge) delivered a series of lectures on theory of fracture. The effects of "quenching" the metals, the techniques for growing crystals with high purity and perfection, the mechanical properties of such crystals, dislocations in semiconductors and twinning in crystals, formed the subject-matters of the other lectures. Dr. A. Seeger (Stuttgart) presented the methods that have been developed for quantitative calculations of the properties of dislocations and other defects. He also reported the results of such calculations on some physical problems.

It is not possible to include all the details of the lectures given during the course of the Summer School. But it is hoped that the above summary indicates the common grounds of interest found by the members working in such diverse fields as metallurgy and nuclear physics, in the course on Physics of the Solid State.

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LETTERS TO THE EDITOR

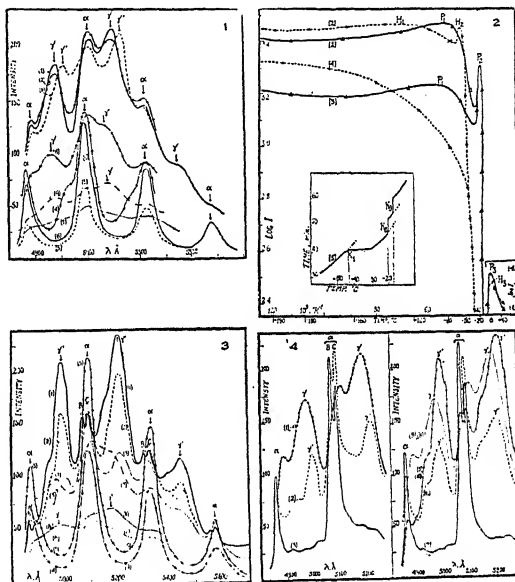
TEMPERATURE DEPENDENCE OF
FLUORESCENCE BANDS OF URANYL
NITRATE SOLUTIONS

RECENTLY Hayakawa and Hirata¹ have reported intensity variations in the fluorescence of uranyl nitrate solutions. They observe two peaks in the T-I curve at -85° and -25° C., of which the latter is ascribed to melting. We have been interested in quantitative measurements of intensities in these spectra for some time now and one of us had earlier observed several complex changes in the T-I curves,² the elucidation of which needed further detailed study. We are now in a position to report the specific conditions under which these intensity changes take place.

What is of profound significance is that for the solution of a given pH and concentration the spectrum not only depends upon temperature, but also upon the manner in which the solution is brought to that temperature. Spectral changes in the range $+25^{\circ}$ to -193° C. have been studied in six different ways: (a) Slow warming of a solution rapidly cooled to -193° C., (b) Slow warming of a solution previously slowly cooled to -193° C., (c) Slow cooling from $+25^{\circ}$ to -193° C., (d) Warming of a rapidly cooled solution to an intermediate temperature θ and recooling rapidly to -193° C., (e) Warming of a slowly cooled solution to an intermediate temperature θ and recooling rapidly to -193° C., and (f) Slow cooling up to an intermediate temperature θ and rapid cooling further up to -193° C.

Figure 1 represents the spectral changes in case (a). The spectrum at -193° C. contains α and γ bands and the intensity variations of these with temperature are shown in Fig. 2. The curve for α bands shows three peaks: P_1 (-75° C.), P_2 (-20° C.) and P_3 (-2° C., melting point). The curve for γ bands similarly shows three peaks: H_1 (-120° C.), H_2 (-60° C.) and H_3 (-2° C.). Just at H_2 the γ bands shift towards the red (Fig. 1, Curve 3), after which they disappear rapidly. They can hardly be traced in the range -35° to -5° C. and then they reappear in the original γ position. In the range H_3 to $+25^{\circ}$ C. their intensity falls less rapidly than that of α bands. Curve 5 in Fig. 2 (inset) shows the variation of temperature with

time for a conc. (4 M)[†] solution. It shows three discontinuities: K_1 (-43° C.), indicating an exothermic change; K_2 (-20° C.) indicating an endothermic change; and K_3 (-17° C.), corresponding to melting in this case. The correspondence between K_1 and the steep fall



FIGS. 1-4. Fig. 1. Fluorescence spectra of rapidly cooled 0.2 M aqueous solution of Uranyl Nitrate at different temperatures during warming: (1) -193° C., (2) -75° C., (3) -60° C., (4) -45° C., (5) -30° C., (6) -20° C., (7) -10° C., (8) 0° C., (9) $+25^{\circ}$ C. (I scale for 7, 8, 9, to read 1/50). Fig. 2. Temperature-Intensity curves (T-I curves) for different bands during warming from -193° C. Curves (1), (2) for α , γ bands respectively of rapidly cooled solution. Curves (3), (4) for α , γ bands respectively of slowly cooled solution. Curve (5) shows variation of temperature with time for a rapidly cooled 4 M solution. Fig. 3. Fluorescence spectra of slowly cooled 0.2 M aqueous solution of Uranyl Nitrate at different temperatures during warming: (1) -193° C., (2) -100° C., (3) -75° C., (4) -35° C., (5) -20° C., (6) -10° C., (7) 0° C., (8) $+25^{\circ}$ C. (I scale for 6, 7, 8 to read 1/60). Fig. 4. Fluorescence spectra at -193° C.: (1), (2), (3) and (4) for rapidly cooled solution warmed up to -100° , -45° , -20° and -10° C. respectively and re-cooled rapidly; (5) (6), (7) and (8) for slowly cooled solutions warmed up to -100° , -45° , -20° and -10° C. respectively and re-cooled rapidly; (9) and (10) for solutions cooled slowly up to -20° and -45° C. respectively and rapidly cooled thereafter.

* Temperatures in the lower range may be in error by 5° C.

[†] Changes are not so distinct in 0.2 M solution for which the spectra have been taken.

in γ intensity, as also between K_2 and peak P_2 in α intensity, is notable.

In case (b) a well-resolved spectrum is obtained at -193°C , containing α bands (split into two components, B and C) and γ' bands (shifted towards the red w.r. to γ). The spectral changes are given in Fig. 3 and T-I variations in Fig. 2. The T-I curve for γ' shows no noticeable hump. In case of α bands the intensity at -193°C is rather low and peak P_2 is very prominent. It may be observed that up to -80°C (about P_1) the C component of α gains over B. Case (c) differs from (b) in the conspicuous absence of peak P_2 .

The spectra observed at -193°C under processes (d), (e) and (f) are given in Fig. 4. The notable features are that by warming the frozen mass up to different intermediate temperatures θ (below melting) and then recooling (i) the spectrum of a rapidly cooled solution can be changed to that of a slowly cooled one and *vice versa*, (ii) the ratio of C to B components can be changed and (iii) the intensities of γ and γ' bands relative to α can be reduced to any extent. The critical values of θ are related with discontinuities K_1 and K_2 (Fig. 2, Curve 5). For example, a rapidly cooled solution warmed to θ between -43° to -20°C . on recooling gives a resolved spectrum, the γ' bands diminishing in intensity with increasing θ .

Details will be published elsewhere. One of us (H. D. B.) is thankful to the Council of Scientific and Industrial Research for financial assistance.

Department of Physics, D. D. PANT.
D.S.B. Govt. College, D. P. KHANDELWAL.
Naini Tal, H. D. BIST.
November 6, 1959.

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DAY-LIGHTING EQUATIONS FOR A STANDARD OVERCAST SKY

EQUATIONS for sky factors for a "Uniform sky" were derived by Yamauti¹ (1924) using a geometrical method. Those equations were used by Rivero² (1958) in the preparation of his tables for a rectangular window of known dimensions.

The International Commission on Illumination (C.I.E.) in its sessional meeting at Zurich³ (1955) defined and recommended for general

adoption a "Standard Overcast Sky" in which the surface intensity of illumination varied with the altitude in accordance with the equation $B_\theta = B_z (1 + 2 \sin \theta/3)$, where B_z and B_θ were the intensities at zenith and at an altitude θ respectively. Tables of sky components for this standard overcast sky were also drawn up by Rivero² (1958) based on his initial tables of sky factors for a uniform sky and using an indirect method of computation.

The author has now derived rigorous trigonometrical equations which can be employed directly. For a point P on the normal to the plane of the window passing through one of its lower corners and distant D from it, the equations

$$L/D = \tan \beta, \quad H/D = \tan \gamma,$$

$$\tan \beta' = \tan \beta \cos \gamma; \quad \tan \gamma' = \tan \gamma \cos \beta$$

define the angles β , β' , γ and γ' subtended at P by the lower and top horizontal sides and nearer and farther vertical sides respectively of the rectangular window of length L and height H. In terms of these angles the derived equations for the different sky components at the point P for a C.I.E. Standard Overcast Sky, for a vertical rectangular unglazed window opening are as follows:

$$F_h = \frac{3(\beta - \beta' \cos \gamma)}{14\pi} + \frac{2 \sin^{-1}(\sin \beta \sin \gamma)}{7\pi}$$

$$- \frac{1}{7\pi} \sin 2\gamma \sin \beta'$$

$$F_{v, \perp} = \frac{3(\gamma - \gamma' \cos \beta)}{14\pi} +$$

$$\frac{2}{7\pi} (1 - \cos \beta - \cos \gamma + \cos \beta \cos \gamma)$$

$$F_{v, \parallel} = \frac{3(\gamma' \sin \beta + \beta' \sin \gamma)}{14\pi} +$$

$$\frac{2}{7\pi} (\sin \beta - \cos^2 \gamma \sin \beta')$$

where F_h , $F_{v, \perp}$ and $F_{v, \parallel}$ are the sky component ratios in the horizontal plane, vertical plane perpendicular to the window and vertical plane parallel to the window respectively, passing through P. The angles are expressed in radian measure.

It is also possible to use the same equations to determine the sky components at any other point not on the perpendicular from one corner of the window.

The first terms in the equations above, but with $1/2\pi$ replacing the factor $3/14\pi$ are the respective Yamauti's equations for a uniform sky. Those equations are also derivable by the general analytical method adopted by the author.

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Derivations of the equations and tables of calculated sky components using them are given in a paper shortly to be published.

Central Building Research Institute,
T. N. SESHADRI.
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A PROBABLE KREITTONITE

LIGHT to skyblue crystals of high hardness (more than 7.5) and specific gravity of 4.5, are collected from the pegmatites of Acari, Rio Grande do Norte state of Brazil. They are taken as guide mineral for Casseterite deposits, and are considered hitherto as lazulite. In paragenetic association are muscovite, cleavelandite, casseterite, tourmaline and tantalite.

They show on close examination, fine crystals of octahedrons, with some deformations. The mineral under the microscope is isotropic, and has a varying high index of refraction, with some grains showing 1.790 ± 0.002 , and the rest higher than the available liquids (1.795).

X-ray photographs showed the following 'd' values for the intense lines (Table I).

TABLE I

Sample 1	Sample 2
2.90	2.89
2.475	2.468
1.573	1.566

Sample 1 has been considered as gahnite, and sample 2, as hercynite. Both the samples show the major elements Zn, Al and Fe, and the minor elements Ca and Ti, under the spectro-scope.

In the studies made on Brazilian minerals by X-ray diffraction, Tavora (1955) records data on a gahnite and a hercynite from Bahia. Table II includes these data and also the A.S.T.M. for comparison.

There is close similarity between the above results of the Zn, and Fe members of the spinel series. The sample studied from Acari shows marked variation and fair deviation from the values in Table II. Also the presence of Fe and Zn in the majors suggests the mineral as

TABLE II

Gahnite (Tavora)	Gahnite (A.S.T.M.)	Hercynite (Tavora)	Hercynite (A.S.T.M.)
2.86	2.85	2.87	2.87
2.44	2.42	2.45	2.45
1.577	1.55	1.562	1.56

a species in between the end members of the spinel series. The unit cell values are also differing from the values of pure gahnite and hercynite. It is, as such, possible that the mineral is either an iron gahnite or a zinc hercynite. The chemical analysis showed the iron content as 20%. Thus it is suggested that the mineral could be classed as Kreittonite (ferri ferroan gahnite from Bodenmais, Bavaria, with total iron oxide 22%).

Detailed chemical work is under progress and will be published elsewhere.

Thanks are due to Dr. John J. Matzko, who has kindly arranged the X-ray photos taken in the D.N.P.M., Rio de Janeiro, by M. Augusto Bptista.

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Universidade do Recife,
Recife, Brazil,
October 24, 1959.

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SOME CARDIOVASCULAR EFFECTS OF DAEMIA EXTENSA IN DOGS

Introduction.—*Daemia extensa* (Ver.—Sanskrit : *Uttaravaru*, Bengali : *Chagulbarta*, Tamil : *Veli-paruthi*) is a permanent twining herb distributed throughout the hotter parts of India. The plant has been used for various maladies in Ayurveda.^{1,2}

The plant contains 2.4% of inorganic salts, a bitter resin and three bitter substances. Bitter principle C is the most active pharmacologically. It has a stimulant action on uterus, intestines, and other smooth muscles due to direct action on the smooth muscles,

Gupta and co-workers,^{4,5} studying the pharmacological actions of the active principles of *Dæmia extensa* on cats, guinea-pigs and frogs, have mentioned that it stimulated involuntary muscles and raised the blood pressure.

Effects of the active principles on dogs probably have not been studied before. The present work is undertaken to study some aspects of the effect of *Dæmia extensa* on the Cardiovascular System of dogs.

Cardiovascular effects of *Dæmia extensa*.—Both aqueous extracts and alcoholic extracts (both 1 in 10 strength) were tried on mongrel

dogs of varying weights. Anaesthesia was induced either with Chloralose i.v. (100 mg./kg or paraldehyde (1 c.c. per pound). Respiration was recorded by Mary's Tambour. General blood pressure was recorded from the carotid artery. Femoral vein was cannulated for injection of drugs. Peripheral blood pressure was recorded from the femoral artery as per Rolf's technique. Myocardiogram was recorded in 5 dogs. The carotid artery was ligated in the middle and into the portions above and below the ligature polythene tubings were introduced; that going headwards was manipulated to reach as near the carotid sinus as possible, as evidence

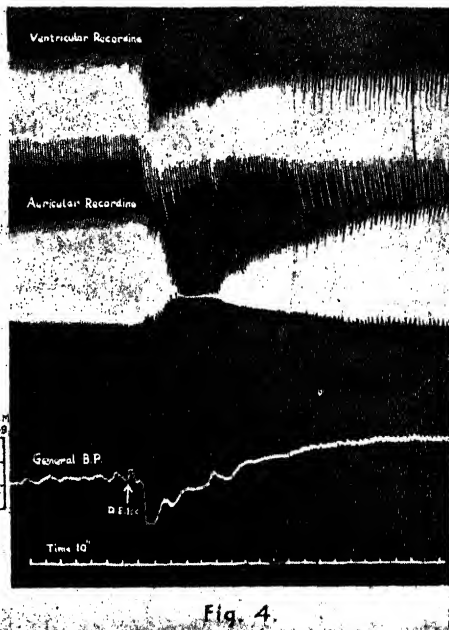
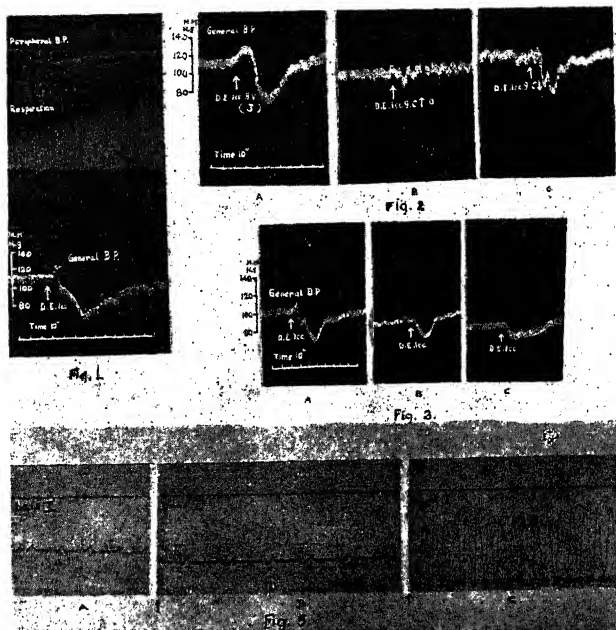


FIG. 1. Dog, 20 lbs. male, Chloralose Anaesthesia. Recordings from above downwards are Peripheral blood pressure, Respiration, General blood pressure and time in 10 seconds. At the arrow, 1 c.c. of alcoholic extract of *Dæmia extensa* was given i.v. (Femoral). A small rise followed by a very steep and prolonged fall of blood pressure of about 40 mm. is noted. Respiratory effect is probably a result of the fall of blood pressure.

FIG. 2. Dog, 18 lb. male, Chloralose Anaesthesia. Recordings of blood pressure and time markings shown. In (A) the effect of *Dæmia extensa* (1 c.c.) injected i.v. into the jugular vein is shown. There is a very steep fall of blood pressure. In (B) *Dæmia extensa* (1 c.c.) was injected into the Carotid Artery towards the head. No effect is seen on the blood pressure. In (C) *Dæmia extensa* (1 c.c.) was injected into Carotid Artery towards the heart. There is a definite fall of blood pressure.

FIG. 3. Dog, 12 lb. female, Chloralose Anaesthesia. Recordings of general blood pressure and time markings are shown. In (A), *Dæmia extensa* (1 c.c.) was injected into the Femoral vein resulting in a fall of blood pressure. In (B), *Dæmia extensa* (1 c.c.) was administered a few minutes after TEA (25 mgm) was given. The hypotensive effect is diminished. In (C), *Dæmia extensa* (1 c.c.) was administered after Atropine (5 mgm.) was given a few minutes earlier. The fall in blood pressure is reduced but not completely annulled.

FIG. 4. Dog, 20 lb. male, Chloralose Anaesthesia. Recordings show from above downwards Ventricular and Auricular Myocardiograms, General blood pressure and time markings in 10 seconds i.v. Administration of *Dæmia extensa* (1 c.c.) produced immediate auricular depression, some ventricular depression, and general fall of blood pressure.

FIG. 5. Dog, 20 lb. female, Chloralose Anaesthesia. E.C.G. Lead I was recorded. In (A), normal E.C.G. Lead I is shown. In (B), after *Dæmia extensa* (2 c.c.) i.v., considerable slowing of heart rate is seen. In (C), after *Dæmia extensa* (9.8 c.c.) Ventricular arrhythmia is to be noted.

by physical check up at the sinus region; the other one going towards the heart was manipulated to reach as near the heart as possible, the position being checked up later. The external jugular vein was also similarly cannulated and the tubing adjusted to reach the left auricle. Drugs were injected into these polythene tubings and the effect on carotid chemoceptor and higher centre as separate from myocardium was studied. E.C.C. was also recorded.

Whatever was the preparation of *Dæmia extensa* used, aqueous or alcoholic, the effect on blood pressure was always the same. Sometimes, there was a small initial rise in blood pressure. However, after injection, there was constant fall of blood pressure and an augmentation of respiration. This fall of blood pressure was not abolished by TEA (by ganglionic block) or Atropine (peripheral parasympathetic block). No fall of peripheral blood pressure was produced when the drug was injected locally. Injection of the extract through the polythene tubings into the carotid artery towards the head did not produce much effect on blood pressure. But Intra-carotid injection of the extract towards and close to the heart similar to intrafemoral (venous) and intra-jugular injections produced immediate fall in blood pressure. Myocardiographic records show a depression of the auricles immediately after injection. Electrocardiographic records show invariably ventricular tachycardia. The fall of blood pressure appears to be chiefly due to a direct depressant action on the heart.

The alcoholic extract is more potent than aqueous extract. About 20-25 c.c. of a decoction of 10 gm. of dried powdered leaves in about 100 c.c. of distilled water is enough to kill an average dog. With alcoholic extract (1 in 10) the dog dies even after about 5-8 c.c.

Summary.—The active principles of *Dæmia extensa* seem to have a definite depressant action on the myocardium in dogs.

Our thanks are due to Mr. S. Gopalan, Pharmacist, for help in this work.

Madurai Medical College,
Madurai, August 25, 1959.

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EFFECT OF ADRENALINE AND ANTISTINE ON CILIARY MOVEMENT IN RELATION TO ACETYLCHOLINE CONCENTRATION IN FROGS OESOPHAGEAL MUCOSA

SINCE the inhibitory effect of adrenaline on different segments of rat intestine has been observed by us to vary with the acetylcholine content of the tissues² and that the rate of acetylcholine has been shown to regulate the ciliary movement,⁴ it is not unlikely that the inhibitory effect of sympathomimetic amines and antihistaminics on the ciliary movement might also be related to acetylcholine synthesis in the oesophageal mucosa. It was therefore thought worthwhile to investigate if this effect of adrenaline and antistine on the rate of ciliary movement and acetylcholine content of oesophageal mucosa in frogs was also mediated through the inhibition of acetylcholine synthesis.

Adult *Rana tigrina* frogs, weighing between 200-250 gm., were divided into three groups. Group I frogs were injected with only normal saline to serve as control while groups II and III were given adrenaline and antistine in 1 mg./kgm. and 50 mg./kgm. doses respectively. Injections were made into the dorsal lymph sac 15-20 minutes before starting the observations.

The rate of ciliary movement was determined from the time taken by poppy seeds to travel a measured distance on the ciliary mucosa of the oesophagus exposed through dorsum in decapitated and pithed frog as described by Burn.⁴ Acetylcholine content of the oesophageal mucosa containing the cilia was estimated biologically on frog rectus as detailed in our previous communication.¹

The effect of adrenaline and antistine on the average rate of ciliary movement and the acetylcholine content per gram of oesophageal tissue is summarised in Table I.

The average values presented in Table I indicate that the rate of ciliary movement as well as acetylcholine content of oesophageal mucosa is significantly reduced after 1 mg./kgm. and 50 mg./kgm. doses of adrenaline and antistine respectively. As the percentage reduction in both these effects has been in the same direction it is likely that these drugs might be acting through inhibition of acetylcholine synthesis which is known to influence both the rate of ciliary movement (*loc. cit.*) as well as acetylcholine content of the tissues.³ In another series of *in vitro* experiments both adrenaline and antistine in 0.2×10^{-6} concentration

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TABLE I

Showing the average rate of the ciliary movement and acetylcholine content of oesophageal mucosa after adrenaline and antistine

Group	Drug	Average rate of ciliary movement (cm./min.)	Reduction of ciliary movement from the control (%)	Average Ach. content of oesophageal mucosa (μ /gm.)	Reduction in Ach. content of oesophageal mucosa from the control (%)
I	Normal saline 0.5 c.c. control	3.84 (\pm .48)	..	0.68 (\pm .098)	..
II	Adrenaline (1 mg./kgm.)	2.56 (\pm .52)	33.3	0.333 (\pm .075)	51.5
III	Antistine (50 mg./kgm.)	2.05 (\pm .20)	46.6	0.283 (\pm .05)	58.8

(which was 5 to 10 times the concentration estimated to be present in oesophageal mucosa after parenteral administration of these drugs) were ineffective in causing any significant inhibition of acetylcholine induced contraction of frog rectus. It is therefore likely that the marked inhibitory effect of adrenaline and antistine on the ciliary movement might be affected through their influence on the *in vivo* synthesis of acetylcholine in the tissues.

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SPECTROPHOTOMETRIC STUDIES OF PENICILLIN SALTS IN RELATION TO THEIR STABILITY

COMMERCIAL preparations of penicillin are expected to maintain their potency within the pharmacopoeial limits for a period of 3 to 4 years from the date of their certification. The pharmacopoeial limits are 10% lower than the theoretical potency to allow for natural fall in potency on storage. However, commercial samples have been observed to have varying degrees of stability. We have made a systematic study of commercial products in regard to their keeping qualities and with a view to determine the cause, mechanism and the degradation products, of the deterioration.

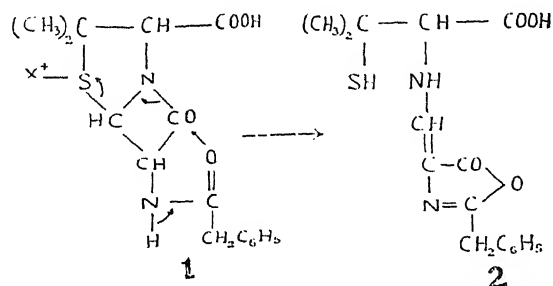
There have been a number of passing references^{1,2,5} to a penicillin degradation product which has an ultraviolet absorption peak at 320 m μ , reported to be present in sodium penicillin samples. The identity of this impurity with benzylpenicillenic acid, an isomerisation product formed by mercuric chloride isomerisation of penicillin, as also by heating an aqueous penicillin solution at pH 4.5, is well established. However, there is no report in literature regarding the influence of this impurity on the keeping quality of the soluble salts of penicillin.

Pure penicillin preparations have characteristic absorption peaks at 252, 257.5 and 264.0 m μ and none at 320 m μ . In our survey with a large number of batches of sodium penicillin G over the last two years, it was noticed that the keeping quality of the samples depended on their initial absorbance at 320 m μ . Some of the commercial preparations showed an absorption peak at 320 m μ , with varying values of E (1%, 1 cm.). It was found that the samples which have an absorbance of more than 0.07 (when determined according to British Pharmacopoeia—a 0.18 w/v solution in water) or E (1%, 1 cm.) at 320 m μ more than 0.392, do not keep very well, the loss in potency being as high as 15% in 2 years.

Samples with very high initial absorbance at 320 m μ , deteriorated from initial potency of 1,640 u/mg. to 1,590 u/mg. in the course of a month. All the cases where the absorbance was less than 0.07 were stable for more than 2 years. Spectrophotometric study of the batches at regular intervals indicated that the absorbance of 320 m μ progressively increased in the case of deteriorating batches while it remained steady in the case of stable samples. This indicates that the impurity which is the cause of the decomposition is also the product of decomposition. This was confirmed by isolation of benzylpenicillenic acid by fractional

crystallisation. This product had a molar extinction of 18,000, agreeing with the value reported by Carpenter *et al.*³

An extra acid group is liberated from penicillenic acid (2), which explains the fall in pH observed in the case of decomposed samples.



The mechanism of isomerisation of penicillin to penicillenic acid (a stabler structure) has been described,^{1,4} but the mechanism of acceleration of the decomposition of penicillin in presence of even traces of this material is not understood. Moisture determinations of the various batches under study did not show any significant increase in the moisture from the original values, thus ruling out the possibility of a hydrolytic type decomposition.

In Table I are given E (1%, 1 cm.) at 320 m μ the original potency and the potency after 2 years, of some of the samples. Fuller details of this study will be published elsewhere.

TABLE I

Sl. No.	E(1%, 1 cm.) at 320 m μ	Original potency μ /mg.	Potency after 2 years μ /mg
1	0.500	1650	1540
2	0.670	1660	1431
3	0.570	1650	1540
4	0.580	1651	1503
5	0.181	1650	1615
6	0.151	1643	1607
7	0.169	1653	1613
8	0.181	1650	1615

Our thanks are due to Dr. K. Ganapathi for his encouragement and interest in this work.

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CHEMICAL PROPERTIES AND CHANGES DURING STORAGE OF SOME INDIAN RAY LIVER OILS *

RAY liver oils are used in leather industry and the yield of oil from fresh good livers ranges from 30-35%. About 4,500 tons of rays are landed annually on the Indian coast. The present note reports the results of investigations on the constants and storage conditions of ray liver oils as the available data about them are scanty.

The fresh livers from the rays landed at Uchipilli, Adirampatnam and Mandapam Camp during December to June 1957-58 were taken and boiled with sufficient quantity of water and the clean yellow oil was ladled and filtered. The yield of the clean yellow oil was 30% and the residual oil was 5%. After the removal of stearine by the cold clearing process the chemical constants were determined by the A.O.A.C. methods. The commercial samples collected at Adirampatnam are mixtures of liver oils of *Dasyatis sephen* and *Rhinoptera* sp. The constants for the liver oils extracted in the laboratory and that of the commercial samples are given in Table I, along with the constants for the Philippine Ray liver oils for comparison.

All the oil samples were stored in plain bottles at the room temperature (27-30° C.) and the iodine value, acid value, peroxide value and the free fatty acids were determined at regular intervals to study the extent of deterioration during the storage period. The results are given in Table II.

It is seen from Table I that the acid values and peroxide values are significant in the commercial oil samples which may be due to improper method of preparation. The liver oils obtained from the *Dasyatis* sp. possess the required characteristics for preparation of sulphonated products.¹ The results in Table II indicate that there is a gradual increase in the acid value, free fatty acids and the peroxide value of the oil during the 5 months storage period. The fall in the iodine value is also

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* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

TABLE I
Physical and chemical constants of fresh ray liver oils

Constants	Mixture of liver oils from <i>Dasyatis sephen</i> + <i>Rhinoptera</i> sp.				Philippine Ray liver oils (2)		
	Ray liver oils extracted in the Laboratory	<i>Dasyatis</i> sp. <i>Atomylacus</i> <i>maculetus</i>	Commercial sample I	Commercial sample II	<i>Dasyatis</i> <i>sephen</i>	<i>Dasyatis</i> <i>uarnak</i>	<i>Dasyatis</i> <i>kuhlii</i>
Oil content	.. 30.45%	30.35%	20.45%	20.45%	19.8%	30%	23.9%
Refractive index at 25° C.	.. 1.475	1.4660	1.470	1.4735	1.4721	1.4756	1.4700
Specific gravity at 25° C.	.. 0.92	0.907	0.920	0.912	..	..	..
Saponification value	.. 188	197.20	195.50	193.40	168	188	170
Iodine number (Hanus)	.. 140	68.63	120.30	134.1	118	127	88
Unsaponifiable matter	.. 1.64%	7.65%	1.78%	2.26%	4.8%	3.0%	7.6%
Acid value	.. 0.31	0.23	4.31	3.33	..	..	..
Water-soluble fatty acids	.. 0.70%	0.12%	0.195%	0.22%	..	..	..
Water-insoluble fatty acids	.. 95.5%	88.08%	84.55%	76.96%	..	..	..
Moisture	.. 0.1%	..	..	..	..	..	..
Colour of the oil	.. Golden yellow	Bright yellow	Light brown	Light brown	..	..	..
Peroxide value	.. Nil	Nil	2.30	3.40	..	..	..
Free fatty acids (expressed as Oleic)	.. 0.16	0.14	2.17	1.67	..	..	..

TABLE II
Changes during storage

Sample	Storage period (days)	Acid value	Free fatty acids (expressed as Oleic)	Iodine value (Hanus)	Peroxide value†	Remarks
Ray liver oil	.. 32	0.37	0.16	140	Nil	..
<i>Dasyatis</i> sp.	.. 76	0.57	0.19	134	Nil	..
	133	0.95	0.48	125	14.09	..
	150	0.96	0.49	124	15.0	..
<i>Atomylacus maculetus</i>	.. 60	0.34	0.17	67.04	11.53	..
	90	0.27	0.13	62.04	15.00	..
	120	0.72	0.36	65.98	20.16	..
Commercial sample I	.. 60	5.18	2.61	108.5	21.91	..
	90	6.33	3.19	102	49.53	Sample discarded
Commercial sample II	.. 60	3.45	1.74	132	20.17	..
	90	5.18	2.61	118.4	40.45	Sample discarded after 3 months

† Number of ml. of .002 N thiosulphate required for 1 gm. of fat.

significant during this period. Excepting the peroxide value of the oil, the values of other constants still agree with the constants required for the preparation of sulphonated oils for use in the leather industry even after 5 months storage. It is not clearly known whether the rancidity of the oil has any adverse effect for its use in the leather industry.

I am thankful to Dr. S. Jones for his keen interest in the investigation. I am also thankful to Shri N. K. Velankar for his suggestions.

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PRELIMINARY NOTE ON AORTIC AFFECTIONS WITH FILARIAL PARASITES IN LOCAL OVINES

So far the known records of filarial worms occurring in the aorta of Indian livestock are only those of *Onchocerca armillata* Railliet and Henry, 1909, in cattle and *Elophora pæli* (Vryburg, 1897) infestations in buffalo. The

former, according to Baylis (1939), was first described, but not named, by Lingard in India but has since been reported by Gaiger (1915), Neveu-Lemaire (1912), Bhalerao (1935), Baylis (1939) and Varma (1953) from different parts of the country while the latter has only been recorded once by Varma (1953) from Assam.

During collection work from a local slaughter-house, one of us (S.M.S.) noticed in a goat carcass in its bulbous aorta and the anterior part of thoracic aorta an unusually large swelling which, when incised, showed on its intima a number of nodules of different sizes and uneven character, with central depressions and ulcerations all round. Somewhat stout but pinkish coloured worms, lying partly or wholly embedded, were easily detected over such areas against the intimal background which, at such spots, was thickened and contained below it a yellowish cheesy mass. There were hæmorrhagic spots at the affected site. However, a very large blood clot of nearly 4 cm. in diameter and 1.25 cm. raised above the general surface carried a number of worms with their protruding parts hanging into the lumen and showing distinct movement. The completely embedded specimens proved to be much younger forms. In all fifteen worms were collected. A well-defined buccal capsule with eight distinct papillæ on its peri-buccal margin was present. Male specimens were 1.5-2.81 cm. while the females were 2.8-4.4 cm. in length. On another occasion two worms, one of each sex, were collected. The more developed males have the characteristic features of the external genitalia and in the more developed female specimens the vulva, vagina and uteri had developed but there were no eggs or microfilaræ.

From study of the buccal capsule, two dissimilar but simple spicules, gubernaculum and caudal papillæ in males and in the position of the vulva in the cesophageal region, the specimen are assignable to the subfamily Diptelonematinae, Wehr., 1935 of Setaniidae, Skrjabin and Shikhobolova, 1945. The type genus *Diptelonema* Diesing, 1861 has been extensively studied, among others, by Chabaud (1952) and Webber (1955) and in the literature the names of the allied genera, *Deraiphorenema* (Romonowich, 1916), *Tetrapetalonema* (Faust, 1935), *Acanthocheilonema* (Cobbold, 1870) are found but because the validity of a few of these has been questioned a confusion exists. Yeh-Liang-Sheng (1957) has proposed re-classification of this and related genera. Following him, the present specimens are provisionally identified as *Tetrapetalonema* sp.

The examination of five other cases from the aorta yielded specimens of *Onchocerca armillata* which was also encountered in sheep but only female worms were recovered.

This is the first record of dipetalonematid filarioid from aorta of goat and cases of aortic onchocerciasis in goat and sheep.

The authors are grateful to Prof. B. P. Pande for guidance, supervision and many criticisms in the preparation of this manuscript.

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STUDIES ON THE DEVELOPMENTAL VARIATION OF AWN IN RICE

LITERATURE on awning in rice refer to such environmental factors as plentiful water-supply, drought conditions, spacing between plants, manuring, etc., affecting awn development. Observations have also been recorded on secondary awning where certain varieties with no awns in the primary panicles develop awns in secondary panicles. The phenomenon of normally awnless varieties producing awns in ratoon crop also comes under the above category. Preliminary studies on the importance of external factors on awn development are recorded here.

A field grown to variety Co. 13 (a short term, non-photo-sensitive and normally awnless variety) was harvested by middle of April and the field was irrigated. Out of 2,342 stubbles 312 sprouted of which 95 survived to flower. All the ratoon plants showed varying extent of awn development.

Another observational trial consisted of pruning the roots before transplanting in an awned variety Ptb. 7, a pure line selection, giving 45-50% awned grains in a panicle. Seedlings of

this variety were transplanted in pots some with the roots intact and others with roots completely pruned. In the series with root-pruned seedlings, the plants had to be supported by stakes in the beginning but subsequent growth was as good as the other series with normal seedlings. It was interesting to note that in pruned series the awn development was restricted (Fig. 1,



PTB. 7A. PTB. 7B.

FIG. 1

Ptb. 7A, normal Ptb. 7B, roots pruned). The average length of awn worked out to 0.78 cm. in the pruned plants as against 1.42 cm. in normal. The percentages of awned grains were found to be 31 and 47.9 respectively. The same phenomenon was also observed in another trial with the tetraploid of another pure line, SR. 26 B. Here in the normal plants the percentage of awned spikelets was found to be 73.96 and the average length of awn was 1.44 cm. In plants with roots pruned, however, the corresponding figures were 68.22 and 0.87 cm.

The secondary awning observed in Co. 13 has no relation to sensitivity to photoperiod since the variety itself is non-photo-sensitive. The shoot growth however was restricted compared

to the root system which developed on the mother plant and remained intact on the ground. This differential development of root and shoot may be one of the factors evoking the expression of awn. In the case of Ptb. 7 and SR. 26 B the delay in root development due to pruning might have inhibited development of awn. It is thus seen that a delayed root development tends to suppress awn in normally awned varieties; in varieties which normally do not develop awns a delayed shoot growth (as in Co. 13 example above) results in its expression. The genetic factors affecting awn development perhaps need for their stability, a specific physiological balance as between shoot and root development and the upset of this balance affects awn expression.

Detailed studies on the above aspects are being initiated.

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ON *SIMARUBACEOXYLON* SHALLOM AND ITS SYNONYMY WITH *SIMARUBINIUM* PLATEN

RECENTLY Shallom¹ has described a fossil wood from Mahurzari in the Deccan Intertrappean Series and has assigned it to a new genus *Simarubaceoxylon* Shallom. However, there already exists a form genus for the woods of *Simarobaceæ*. As long ago as 1907, Platen² had established the genus *Simarubinium* for the fossil woods of this family. This name should have priority over the new name propounded by Shallom. Accordingly *Simarubaceoxylon mahurzari* Shallom should be renamed as *Simarubinium mahurzari* (Shallom) com. nov.

Further, Sprague³ has pointed out that the correct spelling of the family commonly referred to as "*Simarubaceæ*" is "*Simaroubaceæ*". It would be better if this spelling is adhered to in referring to this family.

Birbal Sahni Institute of R. K. JAIN.
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EFFECT OF FERTILIZER PLACEMENT
WITH INOCULATED SEED ON
GROWTH AND NITROGEN FIXING
POWER OF SUB CLOVER (*TRIFOLIUM
SUBTERRANEUM* L.)

VINCENT (1958) reviewed the lethal effects on root nodule organism (*Rhizobium* Sp.) of the inoculated seed when placed in direct contact with fertilizers and insecticides. The effect of such direct placement of different fertilizers with inoculated seed on growth, nodulation and nitrogen fixing power of the host legumae has, however, not been reported. The results of an experiment carried out to obtain this information is reported below.

A pot experiment was designed with two major treatments: (i) Direct placement of fertilizer with inoculated seed, and (ii) Indirect placement, whereby a layer of soil was put in between the fertilizer and the inoculated seed. Six types of fertilizers used, *viz.*, (A) superphosphate, (B) Superphosphate *plus* Calcium carbonate 1:1, (C) Di-calcium phosphate, (D) Di-calcium phosphate *plus* Calcium carbonate 1:1, (E) Calcium carbonate, and (F) Potassium sulphate formed the six minor treatments, replicated four times. Five hundred grams of sterile soil was placed in a small pot, and on the surface of the soil equidistant from the centre, four holes were made with a glass rod (about 3 mm. diameter and 4 mm. depth). Calculated amounts of the fertilizer at the rate of 1 cwt. per acre foot of the soil were placed in each hole and two inoculated seeds of Subterranean Clover were placed directly on the

fertilizer or after covering the fertilizer with a layer of sterile soil, as the case may be. The germination of the seed and the growth of the plants were satisfactory, and the pots received water as and when found necessary. The plants were carefully lifted when 76 days old, nodules on roots counted, dry weights of the whole plants per each pot determined and nitrogen in the plant estimated. The protein value is computed by multiplying total nitrogen of the crop by 6.25. These results presented in Table I clearly show that (i) the effect of indirect placement of fertilizer on nodule numbers, dry matter and total protein is significantly better than direct placement; (ii) irrespective of the nature of placement or the type of fertilizer there is a positive correlation between the nodule count and dry matter production; and (iii) superphosphate as well as di-calcium phosphate have a significant beneficial effect on all the three characters studied over other fertilizers.

The superiority of indirect placement over direct placement is evident even by an observation of the crop growth in the pots as illustrated in Fig 1. These results indicate that the toxic effects of fertilizers on root nodule bacteria of the inoculated seed usually observed in the laboratory in petri dishes can be so severe, even in the soil, as to markedly affect nodulation, dry matter production and nitrogen fixation. This might be one of the reasons for the failure of inoculation in the field, and as such has an important bearing in field practice of drilling the inoculated seed and the fertilizer in the same drill row.

TABLE I

Major treatments placement			Minor treatments (Fertilizers)						Mean
			A	B	C	D	E	F	
			Number of nodules per pot						
Direct	..	..	120	38	106	49	65	21	66.5
Indirect	..	..	152	128	154	116	129	80	126.5
Mean	..	..	136	83	130	82.5	97	50.5	..
			S.E. due to placement effect ± 7.30 ; S.E. due to fertilizer effect ± 9.05						
			Dry matter mg. per pot						
Direct	..	..	3484	1789	3167	1946	2063	1061	2251
Indirect	..	..	3350	3190	3668	2971	2629	2029	3006
Mean	..	..	3517	2489	3416	2458	2346	1548	..
			S.E. due to placement effect ± 191.7 ; S.E. due to fertilizer effect ± 234.8						
			Total Protein mg. per pot						
Direct	..	..	482	228	367	255	264	153	291.5
Indirect	..	..	463	409	485	379	302	253	382.0
Mean	..	..	472	318	426	317	283	203	..
			S.E. due to placement effect ± 12.79 ; S.E. due to fertilizer effect ± 22.15						

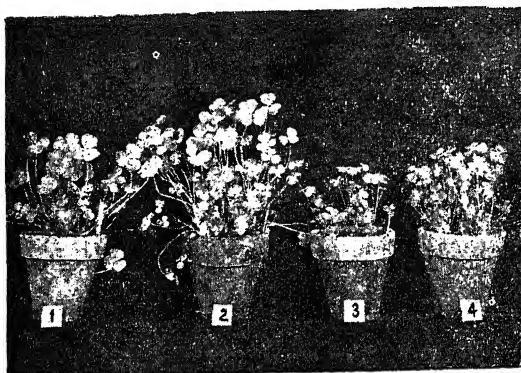


FIG. 1. Direct Placement of Superphosphate.

FIG. 2. Indirect Placement of Superphosphate.

FIG. 3. Direct Placement of Potassium Sulphate.

FIG. 4. Indirect Placement of Potassium Sulphate.

Details will soon be published elsewhere.

To Dr. I. D. Blair, Head of the Department of Microbiology, Canterbury Agricultural College, Lincoln, Christchurch, New Zealand, my grateful thanks are due for suggesting the problem and helpful guidance. Grateful thanks are also due to the Government of New Zealand for the grant of a fellowship under the Colombo Plan which enabled this study.

New Delhi-12,
July 15, 1959.

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STUDIES ON AVAILABLE COPPER IN SOME INDIAN SOILS

SEVERAL workers¹⁻³ have employed the bioassay method of Mulder⁴ for determination of available copper in different soils with considerable advantage. The method is highly sensitive and shows good correlation with actual plant response or appearance of deficiency symptoms. This method as modified by Nicholas⁵ was used for the determination of available copper in some representative Indian soils from some of the important soil groups.

The 'M' strain of *Aspergillus niger* was used for assay. In order to get an idea of the percentage availability of copper in the different soils, these were also analysed for their total copper content by the improved method of Cheng and Bray.⁶ The results obtained are presented in Table I. They show that the different soils have a wide range of variation

in their available, total, as well as per cent available copper content.

TABLE I

No.	Location	Soil group	Available copper $\mu\text{g./g. soil}$	Total copper $\mu\text{g./g. soil}$	% available copper
1	I.A.R.I., New Delhi	Alluvial	1.7	12.5	13.6
2	Pusa (Bihar)	.. do.	1.7	14.0	12.1
3	Jrdore	.. Black	5.0	60.0	8.3
4	Angul (Orissa)	.. do.	6.5	33.5	19.1
5	Bhubaneswar	.. Red	0.9	11.5	7.8
6	Bangalore	.. do.	2.7	27.0	10.0
7	Travancore	.. Peat	9.0	50.0	18.0

The alluvial soils appear to be similar in their available and total copper content. The values for available copper are low and reflect conditions of slight deficiency for copper according to the classification used by Donald *et al.*⁷ Plants growing on these soils might not exhibit symptoms of copper deficiency but might respond to copper application. The red soils particularly that from Bhubaneswar, also show low values for available as well as total copper content. It has been observed that the citrus plantations, in the Bhubaneswar area from where the soil sample was collected, do not thrive well. The low copper content of the soil together with its low availability might be an important factor contributing to this problem. The black soils have given higher values as compared to the alluvial and red soils. These soils may not, therefore, show any response to copper application. The peat soil stands well in the region of non-deficiency and further application of copper may not give any response.

We are grateful to Dr. B. P. Pal, Director of this Institute and Dr. R. V. Tamhane, Head of the Division, for their interest in this work.

Division of Soil Science B. M. LAL.

and Agricultural Chemistry, D. SAHU.

I.A.R.I., New Delhi,

N. B. DAS.

July 10, 1959.

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**A NOTE ON THE TECHNIQUE OF
INFECTING LARVAE OF *CORCYRA*
CEPHALONICA STANTON
(LEPIDOPTERA: GALLERIIDAE) WITH
GREGARINE PARASITES***

In the course of experiments for assessing the effect of gregarine parasites on the secretion of the digestive enzymes in *Corcyra* larva, the author needed a constant supply of 'infected' larvae in large numbers. Though sometimes the larvae collected from stored rice bags were found to contain gregarine parasites in their gut, they were seldom heavily infected. A novel method was, therefore, developed in order to ensure a heavy infection of *Corcyra* larvae with gregarine parasites. Large numbers of eggs obtained in the laboratory from fertilized female moths were mixed up with the food material of the larvae under rearing, most of which were already infected with gregarine parasites. Rearing was done in an incubator at 34° C., in glass jars (8½" × 6½") filled to about three-fourths of their capacity with coarsely milled 'Jowar' mixed with 5% of powdered yeast, and their mouths covered over with muslin cloth. As the infected larvae grew the cysts of the gregarine parasites began to pass out along with the excreta, and got mixed with the food, and the larvae hatching out from the eggs introduced into the jars fed

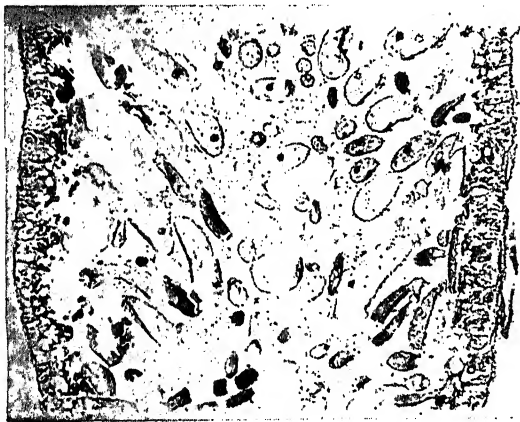


FIG. 1. Photomicrograph of the longitudinal section of the mid-gut of infected larva, showing large number of gregarine parasites.

on this contaminated food and got infected. These larvae in their turn passed out cysts of gregarine parasites along with their excreta and thus the contamination of the food and infection of the larvae continued. Such contaminated food material was mixed with fresh food

supplies and distributed into different jars, in which fresh eggs were introduced, so that the larvae feeding on this contaminated food got heavily infected with gregarine parasites. The photomicrograph (Fig. 1) gives an idea of the intensity of infection of the larvae reared in this way.

I am grateful to Dr. P. D. Gupta for his kind guidance and interest in the work, and to Professor M. B. Lal for the provision of laboratory facilities and finally to the Government of India for the award of a Research Training Scholarship.

Department of Zoology, P. N. SRIVASTAVA.
Lucknow University,
Lucknow, July 23, 1959.

* Part of the thesis approved for the degree of Doctor of Philosophy of Lucknow University in 1958.

**PHORONIS ARCHITECTA ANDREWS
FROM THE VELLAR ESTUARY AT
PORTO NOVO**

GRAVELY¹ briefly reported the occurrence of a single specimen of *Phoronis* from the collections of the Krusadai Island. Recently Nair and Shaw² described the occurrence of *Phoronis australis* Haswell from the Kathiawar Coast of India. The occurrence of *Phoronis* in the Coramandel Coast of India has not been reported so far, although the *Actinotrocha* larva is quite common in the plankton.

Recently, while surveying the bottom fauna of the Vellar estuary at Porto Novo a number of specimens of *Phoronis* were dredged at a depth of 3 to 4 metres in the Vellar estuary about 2 kilometres from the mouth of the river at Station 'B' (Jacob and Rangarajan³). These specimens have the following distinctive features: (1) The formation of isolated tubes with sand grains incorporated into their walls. (2) The great development of the longitudinal muscles. (3) The presence of a ciliated groove in the digestive tract. (4) The relatively small number of tentacles (about 60). (5) The dioecious habit of the animal. These features show that this species is *Phoronis architecta* Andrews which was originally described by Andrews⁴ from U.S.A.

The specimens inhabit slender isolated membranous tubes measuring 30-90 mm. and in a substratum consisting of about 1% coarse sand, 10.6% fine sand, 22.8% very fine sand, 65.6% clay and silt and 2.4% broken molluscan shells. The specimens were dredged when the salinity of the bottom water was as low as 18.02‰ and

as high as 30-62%. The tubes are rarely straight and their anterior ends do not project out from the mud. The animals vary in length from 10-30 mm. and the number of tentacles vary from 60-70. It is interesting to note that *Phoronis architecta* Andrews, originally described from the sea, is found in the estuary at Porto Novo.

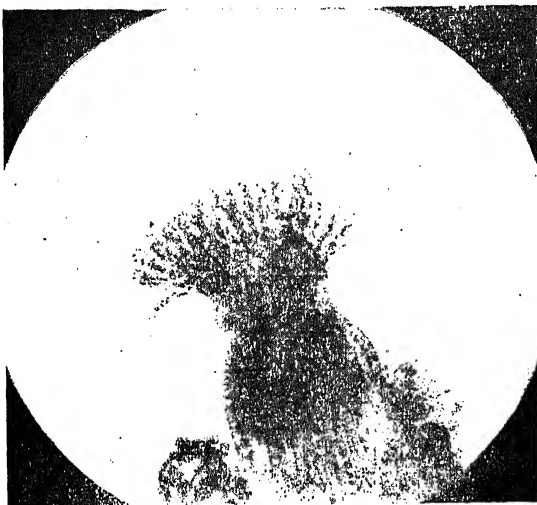


FIG. 1. Photomicrograph of *Phoronis architecta*, $\times 32$.

Blood vessels, septa, body wall, nervous system, alimentary canal and nephridia are like those of *Phoronis architecta* described by Brooks and Cowles.⁵ However, the Porto Novo specimens differ from the American specimens in the following features: (1) The pinnate longitudinal muscle layer is very well developed as in *Phoronis buskii*. (2) The lophophoral organ is a small simple structure and not a complex one. (3) The longitudinal ridge of ciliated gland cells is present in the oesophageal and prestomach regions only. These features may not be of taxonomic value.

My thanks are due to Prof. R. V. Seshaiya, Director, for help and guidance and to the Ministry of Education, Government of India, for the award of a research scholarship.

K. BALASUBRAHMANYAN.

Marine Biological Station,
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OCCURRENCE OF *OZOBANCHUS* *MARGOI* APATHY (HIRUDINEA: ANNELIDA) IN THE INDIAN SEAS

THE genus *Ozobranchus* de Quatrefages, as recently revised¹ includes six valid species, of which only three, i.e., *O. shipleyi* Harding, *O. papillatus* Kaburaki and *O. polybranchus* Sanjeeva Raj, are known from India.

The Mediterranean-species, *O. margoi* Apathy, diagnosed by its five pairs of digitiform gills, was first collected literally in thousands in 1889 and 1894 on the heads of *Thalassochelys corticata* in the Bay of Naples.² Later, after a long interval, in 1927, two specimens were taken on *Caretta olivacea* on the coast of Fukoka and two more specimens were taken earlier by Oka³ quite unusually on a dolphin (*Delphinus longirostris*) from the Sea off Sagami.

In February 1957, over a thousand specimens of *O. margoi* were collected from underneath the right forelimb of a single *Eretmochelys imbricata*, captured alive by the Madras Fisheries Department on the coast of the Bay of Bengal at Ennore, 12 miles north of Madras. The collection includes individuals of all sizes varying between 5.0-19.5 mm. in total length. No cocoons were noticed on the host.

Apathy's original description of this species is unavailable to-day. Oka's account, however inadequate, and Selensky's⁴ comparative anatomical studies are valuable. The latter published in Russian is not easily accessible. Hence there is a need for a detailed account of the morphology and anatomy of this interesting species. This is being prepared for publication elsewhere.

The present record of *O. margoi* Apathy, extends its parasite-host distribution as well as its geographic distribution to the Oriental region also.

Department of Zoology, P. J. SANJEEVA RAJ.
Madras Christian College,
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INHERITANCE OF THE PURPLE CRESCENT ON THE STANDARD PETAL OF *ARACHIS HYPOGAEA* LINN.

THE standard petal of the flower of *Arachis hypogaea* has a purple crescent at the base from which radiate purple lines. There are variations in the intensity of colouration of the crescent in the different varieties, ranging from complete absence to a prominent pattern. This character has been utilized for classification of varieties and types by Hayes² and John *et al.*³ Five grades of colouration of the crescent have been recognised. The complete absence of the crescent has been noted in an Australian white-seeded bunch variety (A.H. 6742) (Bhavani-shankar Rao and Srinivasalu¹). The commonly raised bunch and spreading types have a distinct crescent on their standards. The

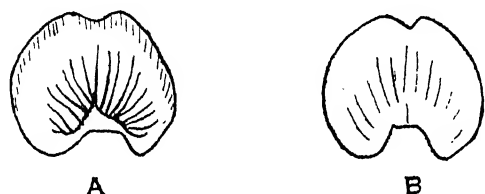


FIG. 1. Standard Petal of *Arachis hypogaea*.
A—Crescent present; B—Crescent absent.

TABLE I

Inheritance of purple crescent on the standard petal of *Arachis hypogaea*

Cross No.	Female parent	Male parent	F. 1	F. 2 No. of plants	
				With crescent	Without crescent
691	A.H. 6742	A.H. 25 (Saloum)	Crescent present	303	22
692	do.	A.H. 477 (Bassi)	do.	191	8
694	do.	A.H. 2105 (Native Tanganyika)	do.	14	1
695	do.	A.H. 45 (H.G. 1)	do.	109	7
696	do.	Forma Erecta	do.	57	4
Total observed				674	42
Expected on 15 : 1 ratio :				671.25	44.75

$$\frac{\chi^2}{m} = 0.18.$$

$$P = \text{between } 0.70 \text{ and } 0.50,$$

inheritance of this character was studied at the Agricultural Research Station, Tindivanam and the results are reported in this note.

Crosses were effected between the Australian white bunch with no crescent and a number of other varieties with distinct and well-defined crescent. The hybrids exhibited the crescent, thereby indicating the dominant nature of the character. The F. 2 population was raised and individual plants were studied for the exhibition of this character. The data on segregation fitted into a double hybrid ratio showing that the character is controlled by two factors.

The results are given in Table I.

The types with no crescent have usually stems devoid of anthocyanin pigment and the seed colour is also white. From studies on the different varieties of *Arachis hypogaea*, it may be said that the anthocyanin pigmentation on the stem is correlated with the presence of crescent on the standard. It is also interesting to note that the inheritance of pigmentation on the stem is also controlled by two factors (Patel *et al.*⁴).

We are thankful to Sri. P. Krishnaswamy, Superintendent, for providing necessary facilities for the study and for guidance.

Agri. Res. Station,

Tindivanam,

July 17, 1959.

N. SRINIVASALU.

N. S. LOGANATHAN.

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CYTOLOGY OF SOME HIMALAYAN MOSESSES-II

IN an earlier communication,¹ the writer reported the chromosome number of 25 Himalayan Mosses not worked out previously. In this report some more families have been worked out and the study has been extended to a number of other localities particularly Darjeeling, Eastern Himalayas. The name of locality is mentioned against each species in Table I.

As the Mosses are a poor storage material for cytological studies, almost all the species were investigated in the field from July to September except *Trematodon sabulosus*, *Physcomitrium cyathicarpum* and *P. repandum* which are the mosses of the plains, and fruit in winter. It was discovered that the Mosses

work better if they are squashed without pre-fixation. This minimized the clumping of the bivalents which is a serious obstacle in counting. Therefore, for most of the Mosses the fresh sporogonia were squashed. The results are summarized in Table I.

TABLE I

Name of the species	Locality	Meiotic chromosome number
DITRICHACEÆ:		
1 <i>Ditrichum tortile</i> (Schrad.) Lindb.	Mussoorie and Darjeeling	14 (13+m)
2 <i>D. heteromallum</i> (Hedw.) Britt.	Darjeeling	13
3 <i>Ceratodon stenocarpus</i> Bruch and Schimp.	do.	13 (14, 15)
DICRANACEÆ:		
4 <i>Trematodon sabulosus</i> Griff.	Hoshiarpur	15
5 * <i>Dicranella heteromalla</i> (Hedw.) Schimp.	Darjeeling	13
6 <i>D. viridissima</i> C. Muell	Mussoorie	16
7 <i>Camptopus gracilis</i> (Mitt.) Jaeg.	Darjeeling	13
8 <i>C. letus</i> (Mitt.) Jaeg.	do.	12
9 <i>C. goughii</i> (Mitt.) Jaeg.	do.	c 12
10 <i>C. pyriformis</i> (Schulz.) Brid.	do.	c 12
11 <i>Oreoweisia laxifolia</i> (Hook.) Par.	do.	14 (13+m)
12 <i>Symblypharis helicophylla</i> Mont. var. A.	do.	14 (13+m)
var. B.	do.	14 (13+m)
LEUCOBRYACEÆ:		
13 <i>Octoblepharum altidum</i> Hedw.	do.	13, 26
CALYMPERACEÆ:		
14 <i>Syrrohopodon gardneri</i> (Hook.) Schwaegr.	do.	13
POTTIACEÆ:		
15 <i>Didymodon rufescens</i> (Hook.) Broth.	do.	13
16 <i>Barbula coruosa</i> Doz. et Molk. Subsp. <i>gangeticum</i>	do.	14 (13+m)
GRIMMIACEÆ:		
17 <i>Racomitrium javanicum</i> Doz. et Molk	do.	14 (13+m)
FUNARIACEÆ:		
18 <i>Physcomitrium cyathicarpum</i> Mitt.	Amritsar	51+1-2 f
19 <i>P. repandum</i> (Griff.) Mitt.	do.	51+1-2 f
20 * <i>Funaria hygrometrica</i> Hedw.	Darjeeling	28
BARTRAMIACEÆ:		
21 * <i>Philonotis turneriana</i> (Schwaegr.) Mitt.	Mussoorie	6

The chromosome number for the above species is being reported for the first time except those marked * f. 'm' stands for the minute bivalent characteristic of many bryophytes.

The two species of *Physcomitrium* show highest grade of polyploidy (Fig. 1), yet reported for an Indian species of this genus.



FIG. 1. Microphotograph of *Physcomitrium cyathicarpum* showing 51 bivalents and a fragment (f), $\times 1,70$.

The writer gratefully acknowledges the encouragement given to him by Prof. P. N. Mehra during the course of investigation. He is indebted to Messrs. R. S. Chopra (Botany Department, Panjab University) and A. H. Norkett (British Museum, Natural History, London) for their kind help with the identification of the above species. Thanks are also due to Mr. R. S. Pathania for the microphotograph of *Physcomitrium cyathicarpum*.

Botany Department, K. R. KHANNA,
Panjab University,
Amritsar, July 2, 1959.

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AN ASPECT OF GAMMEXANE (HEXA-CHLORO-CYCLO-HEXANE) EFFECT ON CHROMOSOMES

THE importance of gammexane as a polyploidising and chromosome-breaking chemical has been well amplified (D'Amato, 1949, 1950). Its property as such stands comparison with that of colchicine.

However nothing is known yet as to the permanency of the effect of gammexane. Experiments were planned to test the effect of this chemical on root tissues subjected to prolonged and short treatment following recovery in water or Knop's medium. As some very significant results have been obtained an immediate announcement has been thought desirable.

As toxicity was found to be caused in higher concentrations, young bulbs of *Allium cepa* were grown in a very low concentration, viz., dec. 0007% solution of gammexane for 20 days at 30° C. In another set of experiments bulbs were transferred to Knop's medium after 7 days of treatment. Observations on root-tip squashes were made following aceto-orcein technique every 24 hours.

solution gradually revealed somatic reduction as well as star metaphases within the cells resulting in multinucleate tissue. As many as 9 to 10 star metaphases could be counted in a single cell following 264 hours of treatment.

Gradually, the polyploid cells tended to decrease and after 480 hours of treatment, nearly all the dividing cells were found to be diploid. It is apparent that through the formation of star metaphases and somatic reduction cells with lower numbers are formed and those approaching the normal diploid condition survive. In addition to these irregularities, fragmentation and lagging too were not infrequently observed.

In another set in which recovery was performed in Knop's medium similar behaviour was noted excepting the fact that in Knop's medium, no other irregularities such as fragmentation, etc., could be detected.

The above results bring out clearly one remarkable aspect of gammexane effect manifested by the attainment of immunity of the tissue through somatic reduction and star metaphases following prolonged treatment in the chemical. It stands out markedly from colchicine in the transitory nature of its effect as the polyploidy once induced gradually reverts back to normal condition as soon as the influence of the chemical is removed.

The work has been carried out in a scheme sponsored by the Council of Scientific and Industrial Research, New Delhi, to which our thanks are due.

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Calcutta-19, July 24, 1959.

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A NOTE ON HEXAPLOID SORGHUM

KRISHNASWAMY *et al.*^{1,2} reported certain abnormal types of meiosis in diploid grain sorghums and discussed the possibility of recovering from them octoploid, hexaploid and aneuploid plants. Subsequently, a hexaploid was obtained by dusting the stigma of desynaptic autotetraploid *Sorghum subglabrescens* ($2n=40$) with the pollen from allotetraploid grain sorghum ($2n=40$). This male parent has already been described in a previous paper.³ The chromosome

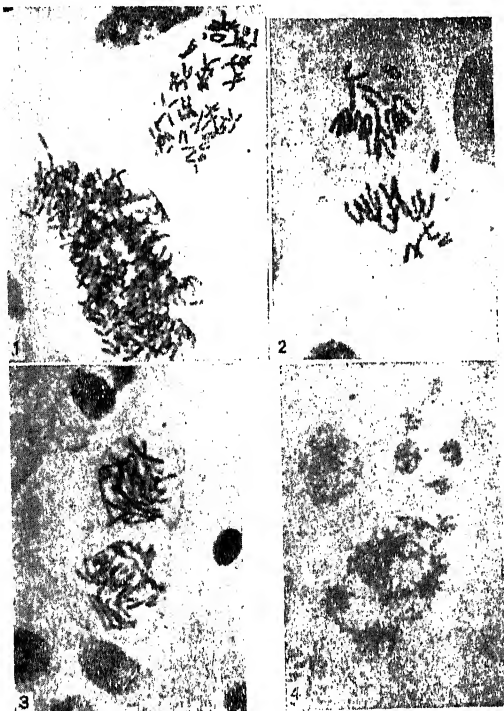


FIG. 1. A high polyploid cell, the other cell shows diplochromatids.

FIG. 2. Anaphase showing fragment.

FIG. 3. Somatic reduction showing double chromatids.

FIG. 4. Star metaphases and multinucleate condition.

Colchicine mitosis was noted after 24 hours and frequency of polyploid cells were found to increase with continued period of treatment. Degree of polyploidy too was found to increase considerably and after 144 hours it reached its maximum having more than 200 chromosomes in a cell. Tumour formation started after 3 days of treatment. Further keeping in gammexane

number of the latter was determined by counts on root-tips as well as pollen mother cells. A brief description and behaviour of this hexaploid is presented in this note.

The hexaploid was vigorous, tall and tillering fairly. The lengths of the awn and glume were longer than those of the tetraploid mother. Pollen fertility was five times greater than in the pistil plant. The narrow base of the leaves, grains that were partly exposed and the brown wash on the reddish colour of the grain were noted particularly, as they were characters associated with the pollen parent.

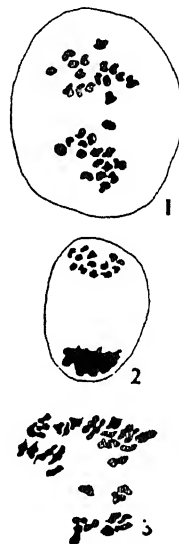
The meiosis of the hexaploid revealed associations ranging from hexavalents to univalents (Maximum association, $2_{VI} + 4_{IV} + 14_{II} + 4_I$; minimum association, $15_{II} + 30_I$; Mean association per cell, $0.44_{VI} + 0.08_{V} + 2.17_{IV} + 0.61_{III} + 16.2_{II} + 13.76_I$) and did not show much abnormality. However, random distribution of the univalents or their division at anaphase, and formation of restitution nuclei were sometimes observed at interkinesis. At tetrad stage, it was noted that the cytoplasm gave rise to extra cleavages rarely. These bits of cytoplasm also enclosed a univalent, a fragment or no chromatin at all, thereby leading to the formation of supernumerary spores. The seed setting varied from 27.8% to 3.4% in the 13 panicles that were harvested.

This hexaploid is the product of fusion between an unreduced egg of the desynaptic autotetraploid *S. subglabrescens* and the reduced gamete of the allotetraploid grain sorghum. The hybrid origin of this hexaploid is further indicated by its characters like narrow base of the long leaves, partly exposed grains with the characteristic brown wash, etc., which are typical of *S. halepense*. The origin and cytological behaviour of the hexaploid suggest its auto-allopolyploid nature.

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May 1, 1959.

CHROMOSOME NUMBER IN SOME SPECIES OF *HELIOTROPIMUM*

THIS note is a report of the chromosome numbers, as determined from the dividing pollen mother-cells, in *Heliotropium undulatum* Vahl, *H. strigosum* Willd., and *H. eichwaldi* Steud. Meiotic studies in *H. undulatum* and *H. strigosum* revealed 16 and 13 respectively, to be the haploid chromosome numbers of the species. The separation of chromosomes at anaphase I was regular in both the species (Figs. 1 and 2). As far as the authors are aware this is the first report of chromosome number in these species. The plants of *H. eichwaldi* showed 32 bivalents at diakinesis and metaphase I (Fig. 3).



FIGS. 1-3. ($\times 710$). Fig. 1. *Heliotropium undulatum*—Anaphase I showing sixteen chromosomes at either pole. Fig. 2. *Heliotropium strigosum*—Anaphase I with thirteen chromosomes on one side. Fig. 3. *Heliotropium eichwaldi*—Metaphase I showing thirty two bivalents.

The same number was counted at anaphase I and metaphase II. The observations regarding the chromosome count of *H. eichwaldi* are in conformity with an earlier report¹ where 32 was reported to be the haploid number of this species.

We are grateful to Principal, Dr. A. N. Banerji, for providing the necessary facilities.

Botany Department, C. P. MALIK.
Deshbandhu College, S. M. SEHGAL.
Kalkaji, New Delhi-19, S. L. TANDON.*
April 16, 1959.

* Reader in Botany, University of Delhi, Delhi-8.

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**PUPA OF *OZOTOMERUS MACULOSUS*
PERROUD (COLEOPTERA,
ANTHRIBIDAE)**

Ozotomerus maculosus Perr. is a sapwood borer. Recently on 13th February 1959, a few specimens of its larvæ and pupæ were extracted from a top dried sal (*Shorea robusta*) pole from Ranipokhri Vested Forests, Barkot Range, Dehra Dun Forest Division. Gardner (1932, 1936) has described its larva and Beeson (1919, 1941) and Mathur (1957) have given its distribution, food-plants and brief biological data. Its pupa is described below:

Pupa.—(Figs. 1 and 3) Length about 7.5 mm., width 3.0 mm. Uniformly white when newly formed. Tips of elytra roundly knobbed attaining the fifth sternite; with a large, vertical knob-like papilla (Figs. 3 and 4) projecting

reaching up to the anterior portion of seventh sternite. Head ventral, rounded, thickly beset with hairs arising from short tubercles. Beak short and broad. Antennæ non-geniculate, lying transversely and reaching near to the postero-lateral corners of the prothorax. Prothorax somewhat dome-shaped and thickly beset with minute points; anterior region armed with a row of setigerous tubercles, with scattered thick setæ and also sparsely provided with long hairs arising from minute tubercles (Fig. 2); antero-lateral angles armed with a bunch of long hairs; posterior border prominent, moderately swollen and provided with a transverse row of fine hairs borne on minute tubercles; a broad, shallow postero-median depression also present above the posterior border. Mesonotum moderately transverse.

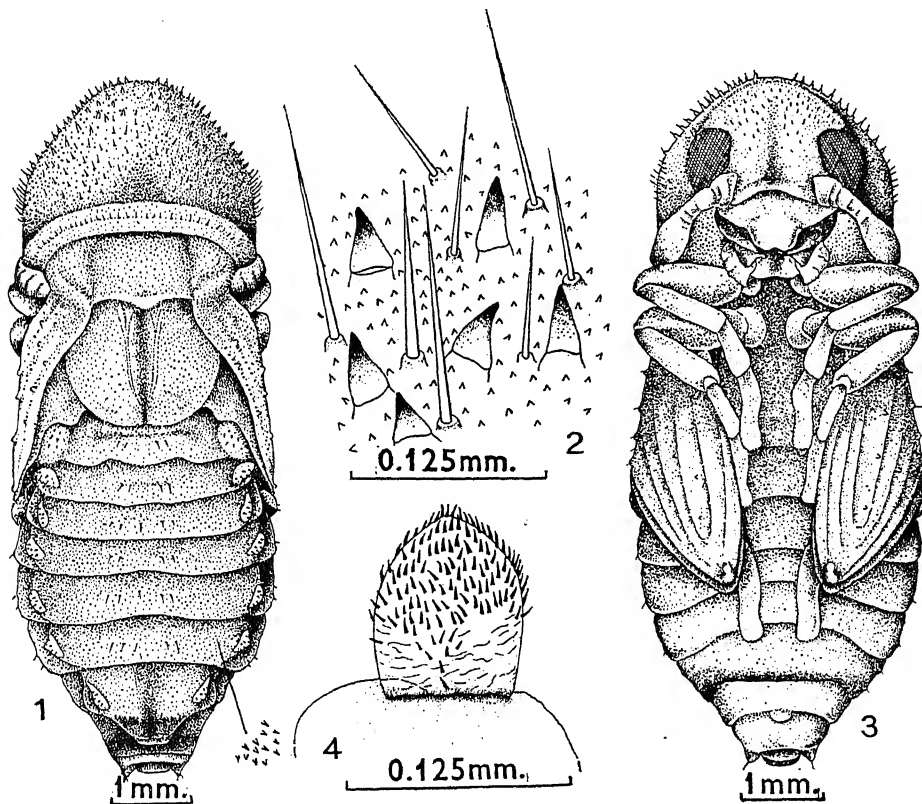


FIG. 1. Pupa of *Ozotomerus maculosus* Perr.; dorsal aspect. FIG. 2. Various types of setæ on prothorax.

FIG. 3. Pupa of same; ventral aspect. FIG. 4. A knob-like papilla near tip of elytra.

just above the tip and beset with a brush of Metanotum broadly transverse, with a longi-
thick setæ; some small papillæ also present tudinal median groove.

in rows on the elytra. Metathoracic wings Skin of abdomen thickly beset with minute
slightly longer than the elytra. Metathoracic points. Abdominal tergites deeply grooved
tarsi extending well beyond tips of elytra and intersegmentally, first six tergites narrowly

transverse, having a few fine median hairs, each tergite with a lateral ridge armed with a group of thick setae and fine long hairs borne on small tubercles. Seventh tergite large, broad and transversely swollen in middle, sloping gradually both anteriorly and posteriorly, also with a deep longitudinal median groove, lateral ridges prominent and armed with thick setae and a few fine hairs originating from small tubercles, posterior slope beset with a few fine hairs and thick setae. Epipleural lobes each provided with two or three fine hairs. Ninth segment small, vertical, having a few fine hairs, with two lateral processes armed with a few setae. Tenth segment small and ventral to ninth segment.

Forest Research Institute, R. N. MATHUR.
Dehra Dun, July 18, 1959.

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SMICRONYX ALBOVARIEGATUS FAUST, CAUSING ROOT-GALLS ON STRIGA SPP.

DURING 1955 observations had been made of a weevil—*Smicronyx albovariegatus* Faust (Curculionidae: Coleoptera), causing galls in stems and eating into the seed capsules of *Striga* (Khan and Murthy, 1955). Its seasonal history as occurring in the Nizamsagar Canal area of Nizamabad District, Andhra Pradesh, had also been included therein.

The present note is to record another mode of injury this weevil causes to the *Striga* plants. In the course of a tour in the Jowar-growing areas of Chamarajnagar Taluk in Mysore District in August 1959, and Gulbarga District in November 1959, the writer came across patches of *Striga* plants marked by pallor, and bearing fewer branches, flowers and seed cap-

sules. A careful uprooting of the plants revealed the presence of a number of galls on the roots of these plants (Fig. 1). On dissection, a few galls revealed the presence of the grubs of *S. albovariegatus* though in the majority of cases the grubs had already emerged from the galls for pupation in the soil.



FIG. 1. *Striga* plants with both stem and root-galls.

It is seen that on account of the presence of root-galls there is a weakening of the *Striga* plant which may perhaps be due to the impaired absorption of nutrients due to root damage. In view of the fact that the weevil grub also destroys the seed capsules, *S. albovariegatus* may possibly exercise some degree of natural control of this phanerogamic root parasite in the field.

The writer is grateful to Dr. M. Puttarudriah for encouragement and guidance. The photograph was taken by Sri. P. Raghuram, Senior Artist, to whom the writer's thanks are due.

Division of Entomology, D. V. MURTHY.
Department of Agriculture,
Bangalore, September 15, 1959.

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REVIEWS

Principles of Statistical Techniques. A First course from the beginnings for Schools and Universities. By P. G. Moore. (Cambridge University Press), 1958. Pp. viii + 239. Price 22 sh. 6 d. net.

This is an elementary text-book on Statistics written for High School students and may be useful for University classes also. As the author states in the Preface, this book is an attempt to put across the main principles of statistical methods to students who are fundamentally interested in the practical applications of the subject and are not so much concerned with the philosophical bases of the concepts used. Mathematical ideas and symbols have therefore been reduced to a minimum and the book therefore will find its use especially to non-mathematical readers. The following chapter headings will give an idea of the contents of the book: (1) The Scope of Statistics, (2) The Collection of Data, (3) The Tabulation of Data, (4) The Pictorial Representation of Data, (6) Averages, (7) Measures of Dispersion, (8) Probability and sampling, (9) The Binomial Theorem, (10) Tests of Significance, (11) Further Tests of Significance, (12) Further Forms of Average, (13) Time Series, (14) Pairs of Characters.

V.

Mass Spectroscopy. By H. E. Duckworth. (Cambridge University Press), 1958. Pp. 206. Price 35 sh.

Mass spectrometers are nowadays commercially available instruments having applications mainly as an analytical tool. In its basic form, the instrument is a simple one in which charged ions undergo deflections in the presence of a magnetic field and undergo splitting according to their masses. Efficient operation of mass spectrometers demands a thorough knowledge of vacuum techniques, positive ion production and positive ion optics and detection methods. The positive apparatus of J. J. Thomson may be said to be the forerunner of the mass spectrograph which was first constructed and operated by Thomson. Since then many improvements have been made to the original mass spectrograph, especially on the detection side. The monograph under review in its first chapter traces the development of mass spectroscopes and passes on to positive ion optics, sources of positive ions and

detection methods in Chapters 2, 3 and 4 respectively. The next two chapters deal with deflection-type instrument and time of flight mass spectrometers. Chapters 6 to 10 deal with the applications of mass spectroscopy; determination of isotopic abundances; determination of atomic masses; application to nuclear research; ionisation and dissociation of molecules under electron impact. In the last chapter its application to geology is set out. In the appendix is given a table of naturally occurring nuclides, giving their isotopic abundances and masses. The monograph is a very good introduction to this very important technique.

A. J.

The Magneto-Ionic Theory and Its Applications to the Ionosphere. By J. A. Ratcliffe. (Cambridge University Press), 1959. Pp. x + 206. Price 40 sh. net.

In Professor S. K. Mitra's book on the Upper Atmosphere which was first published in 1947, there was an important section dealing with the propagation of electro-magnetic waves through an ionized medium in the presence of an external magnetic field on the lines of Appleton and Hartree's treatment of the subject. There have been important developments of the subject since then, and there was need for a comprehensive text-book dealing with the subject in a critical and physically understandable way. Prof. Ratcliffe's book well supplies the need.

The book is divided into four parts. In parts I and II, the equations of the magneto-ionic theory are derived with a clear statement of the assumptions. The equations are solved and the solutions are interpreted with the aid of numerous graphs both when there is no magnetic field and when there is a magnetic field. The effects of collisions and the nature of absorption in an ionized medium are discussed with great clarity. There is a chapter on group velocity in an ionized medium with and without magnetic field, a topic of great importance for determining electron density distributions in the vertical from ionospheric records.

In Part III, the equations and curves developed in the first two parts are applied to a model ionosphere. Some controversial questions such as triple splitting of ionospheric echoes and splitting near the gyro-magnetic frequency are discussed.

Part IV deals with a number of miscellaneous questions such as the Lorentz term in the magneto-ionic theory, the propagation of waves when there is a mixture of ions and electrons and the similarities and points of difference between propagation in a magneto-ionic medium and in a doubly-refracting crystal. The author gives reasons for preferring the Sellmeier theory, omitting the Lorentz term in the equations of the magneto-ionic theory. The problem of wave propagation in an inhomogeneous medium has not been dealt with in a mathematical way, but a descriptive account of the results of the wave treatment is given in Chapter 17.

The approach of Professor Ratcliffe is throughout from the side of physics. Physical ideas are kept in the foreground and they are built up step by step. Difficulties are anticipated and clarified. The implications of a mathematical result are examined in detail with an unstinting use of clear diagrams. The book is well printed and will be welcomed by all students of Ionospheric Physics.

K. R. RAMANATHAN.

Infra-Red Absorption Spectra. Index for 1945-57. By Herbert M. Hershenson. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1959. Pp. 11. Price \$ 7.00.

The present volume forms a companion to the previously published *Ultraviolet and Visible Absorption Spectra: Index for 1930-54*. It contains about 16,000 references to published Infra-red Absorption Spectra in 33 important American and European journals, and one book. For finding the actual spectrum of any compound, the original reference cited must be consulted. With the increasing spate of literature on Infra-Red Spectra, such an index becomes—for the chemist and the Infra-red spectroscopist—a necessary addition to the library.

S. P.

Methods of Experimental Physics. Vol. I. Classical Methods. Edited by I. Estermann. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1). 1959. Pp. 596. Price \$ 12.00.

Teachers and students reading this book will find in it a series of enjoyable and readable survey articles of various topics in classical physics written at graduate level by various authors. Experimental research workers on the other hand, to whom the title of the series may conjure up visions of a worthy successor to Strong's classic, or Glazebrook's 'Dictionary'

will be slightly disappointed with this first volume. According to the preface, however, the book was not intended to be a "cook book" giving detailed description of favourite recipes'. But it may also be questioned whether the cursory delineation or the theoretical bias found in some of the chapters have helped this volume to become a "guide book" which points out the advantages, capabilities and limitations of the various methods and thus enable the user to select those which appear appropriate to his particular problem'. Thus, Raman scattering is disposed away in half a page, without so much as a reference to the texts where the techniques relating to this field may be found. Then again, the chapter on Thermodynamics contains a purely theoretical discussion of the subject. However, even the critical reader must admit that the volume—like the curate's egg, is really good in parts, and so would be a useful addition to a scientific library.

S. P.

Analytical Chemistry of Polymers. Part I. Analysis of Monomers and Polymeric Materials. Plastics—Resins—Rubbers—Fibres. Edited by Gordon M. Kline. (National Bureau of Standards, Washington. (Interscience Publishers), 1959. Pp. xviii + 666. Price \$ 16.50.

This book presents for the first time a comprehensive account of the analytical methods employed for assessing monomers and polymers. The twenty chapters of the book cover the following subjects: Acrylic plastics, alkyds, aminoresins, cellulose derivatives, epox resins, ethylene and fluoroethylene polymers, furan resins, natural resins, phenolic resins, polyamides, polyesters, proteins, rubbers (elastomers), silicones, styrene monomers and polymers, vinyl polymers and copolymers, ion exchange resins, plasticizers, synthetic and natural fibres, and drying oils. The contributions are from chemists of well-known companies manufacturing monomers and polymers, such as the Hercules Powder Company, American Cyanamid Company, Shell Chemical Corporation, Union Carbide, Rohm & Haas, and Dow Chemical Company. Methods for the determination of impurities present in monomers are described, and analytical problems in investigating the chemical composition and physico-chemical properties of polymers are discussed. Except for some unpublished tests, procedural details are avoided and more attention is paid to basic principles, supplemented by numerous references to the original literature. Because of the extremely wide field which is covered, it is inevitable that some materials and methods have

been treated in considerably less detail than others. For instance, the three short paragraphs on the identification of synthetic and natural fibres by staining with dyes give no indication at all of the dyes that are actually employed or the basis on which the fibres are differentiated. Rosin and shellac, which are of special interest to this country, are dismissed with the sentence "Rosin and shellac are not included in the discussion of the natural resins". Cashew-nut shell liquid is not mentioned. Nevertheless, this is an invaluable reference book for chemists and technologists concerned with any aspect of monomers and polymers. A subsequent volume will deal with chemical group analysis, molecular structure determination and identification procedures for polymers.

K. V.

Combination of Observations. By W. M. Smart. (Cambridge University Press), 1958. Pp. 253. Price 35 sh. net.

Mathematical methods of interpreting experimental data are not only confined to the realm of physical sciences but have spread to such diverse fields as population studies, economics and biology. The difficulty of measuring a particular quantity with absolute accuracy can, to some extent, be overcome by making several independent observations and by combining these to give the most probable result. The book begins with the general principles of statistical theory and methods and then passes on to Error Theory. The basic concepts of the probability theory is provided in the 3rd chapter. In the 4th and 5th chapters are discussed the Measure of Precision. Later chapters discuss conditions involving general unknown quantities; the representation of statistical distributions by mathematical functions; exceptional measures and the correction of observed frequency distributions; and finally the important question of correlating sets of two or more different observed quantities. The appendices give tables of the more important functions used in the combination of observations. Numerous examples from a wide range of disciplines give an insight to the readers as to how the different methods could be applied to practical cases.

A. J.

Metal Fatigue. Edited by J. A. Pope. (Chapman and Hall Ltd., London), 1959. Pp. xiv + 381. Price 70 sh.

The phenomenon of fatigue failure of metals and alloys has long remained "an enigma

wrapped in mystery". The complex mechanism of fatigue failure is yet to be fully understood, but it is now common knowledge that such failures are brought about by the formation and extension of cracks in response to alternating or repeated stresses that are below the elastic limit. The design engineers are also aware of the fact that at least half, and perhaps very much more, of service failures in the components of high-speed machines are to be accounted for by metal fatigue. The best method of preventing such failures in future is to collect, study and use as much of experimental data as possible concerning the fatigue properties of common engineering materials. Most of the data in this field are obtained by accelerated fatigue tests in the laboratory and have to be correlated intelligently and carefully with actual service experience. The literature on this subject is growing and has perhaps to grow much more to be of reliable assistance to the design engineer. It is in this context that the present volume is very welcome as a reference book for the practising engineer.

This book derives from a week's residential course on the *Fatigue of Metals* held for professional engineers in the Engineering Department of Nottingham University in September 1955. Twenty lectures were given in this course by 15 experts drawn from both the industry and the University. The texts of these lectures are published here in three parts: (1) The fundamental of Fatigue; (2) The Fatigue properties of engineering material and components; (3) Fatigue testing of engineering components. The first part should be of interest to the advanced engineering student, the researcher as well as the design engineer, but the latter two parts are specially for the design and development engineer. The organizers of the course deserve warm congratulations for having undertaken the task of publishing the lectures in an attractive volume with numerous tables and illustrations carefully selected from recent publications. This book deserves to be in the hands of each and every designer.

T. R. ANANTHARAMAN.

The Chemistry of Natural Products. Vols. II and III. By P. de Mayo. (Interscience Pub., New York), 1959. Pp. vii + 320 and vii + 239. Price \$ 7.50 and \$ 6.00.

Next to steroids, recent studies in the field of terpenoids have promoted knowledge of cyclisation, rearrangement, substitution and elimination reactions, stereo-chemistry, absorption

spectra, rotation differences and rotatory dispersion. For some time the want of a text-book dealing with the latest developments in this field has been felt, and this has been very adequately met with by the recent two volumes of "*The Chemistry of Natural Products*—Vol. II *Mono- and Sesquiterpenoids* and Vol. III, *The Higher Terpenoids*". Within the limit of remarkably short space the author—P. de Mayo—has developed the subject-matter in each chapter hardly missing any significant fact. The mode of presentation should make these volumes very valuable for teachers and students alike.

D. K. BANERJEE.

Excursion Flora of the British Isles. By A. R. Clapham, T. G. Tunin and E. F. Warburg. (Cambridge University Press), 1959. Pp. xxxiii + 579. Price 23 sh. 6 d.

This handy reference book, as the name suggests, is designed to meet the demands of the student of systematics in his field studies and is a condensed form of the more voluminous work, the *Flora of the British Isles* by the same authors published in 1951. The present work, although as thorough and exact as the larger one, is more portable and cheaper, and can easily slip into the collecting bag. It includes, in addition to the descriptions, a sequence of orders and families and also a key to the families, both of which enhance the value of this little book very considerably as a work of ready reference. The descriptions of families and species are concise and clear, and the keys to the genera exact and precise. In order to save space the number of species dealt with in the larger *Flora* has been reduced here, and all text-figures have been omitted. Otherwise, the *Excursion Flora* has some improvements over the larger work, such as the inclusion of certain native species not found in the larger book, and some taxonomic and nomenclatural changes. The reduction in the size of the book has, however, involved the omission of some matter of interest to the more advanced students of systematics and the authors have, therefore, rightly hoped that those who start with the smaller *Excursion Flora* would progress to the larger work.

The *Excursion Flora* is well suited to the requirements of the University students taking Botany as one of the subjects for the degree course. It has a useful glossary of terms and an index at the end. The printing throughout is good and the general get-up of the book excellent. The authors deserve to be congratulated on bringing out such a work, and it

should find a place prominently in all Botany libraries. It is, however, to be doubted whether the price of the book is low enough to tempt students to possess their own copies, at least in this country.

ESBEEKAY.

Bacteriophages. By Mark H. Adams. (Interscience Publishers, Inc., New York), 1959. Pp. xviii + 592, with Glossary, Appendix and illustrations. Cloth bound. Price \$15.00.

The book is an up-to-date, authentic and complete, yet a concise account on the subject of Bacteriophages. The first detailed book on the subject was written by d'Herelle as far back as 1926, after the discovery of bacteriophage. Since then extensive research on the subject has been going on the world over. The information has been so voluminous and varied that a need for such a book as this was keenly felt by research workers, students and clinicians alike. Mark Adams has done well in writing this book which contains even the critical evaluation of the latest research findings. Today, bacteriophage is not only used for typing the bacterium but also as a model virus in virus research.

The book is divided into 22 chapters excluding the glossary, methods of study, index and bibliography. Further, at the end of each chapter, there is a useful summary. The inclusion of glossary and methods of study has been most thoughtfully done, so as to be helpful both to the beginner and the research worker. When the book was about to be completed, Adams died at the early age of 44 and the task of completing the remaining portion of the book fell on E. S. Anderson, J. S. Gots, F. Jacob and E. L. Wollman, while the responsibility of editing fell on A. D. Hershey. E. Kellenberger is responsible for the excellent electron micrographs. The book is useful both for beginners and advanced students on the subject and should find a place in the bookshelf of every Bacteriological and Virus Laboratory.

V. N. K.

Methods in Enzymology. Vol. IV. Edited by S. P. Colowick and N. O. Kaplan. (Academic Press, Inc., Publishers, New York; India: Asia Publishing House, Bombay-1), Pp. 979. Price \$24.

The preparation and assay of enzymes and substrates have been the subjects of the first three volumes of this series on "Methods in Enzymology" edited by S. P. Colowick and N. O. Kaplan; these have since

become excellent handbooks in the laboratory for ready reference on the numerous enzyme systems. This volume, the fourth in the series, deals with certain specialized techniques for characterization of proteins, for metabolic studies and for isotope studies which an enzymologist will have occasion to use during the course of his work. Although these subjects have been exhaustively treated in various monographs and publications individually, the editors have felt the need to have them rewritten in order to be particularly suitable for the enzymologist and have therefore included them in this series so as to make this collection a comprehensive treatise on enzymic methods.

The first section on "Techniques for Characterization of Proteins (Procedures and Interpretations)" contains such topics as electrophoresis, paper electrophoresis, ultracentrifugation, diffusion and viscometry, infra-red spectrophotometry, X-ray diffraction of protein crystals, light scattering measurements, flow birefringence and fluorescence. The authors of these articles have described the theoretical and experimental aspects of these methods in detail along with appropriate interpretations. These have been followed by articles on the determination of amino-acid sequence by dinitrofluorobenzene and pipsyl methods and by the usual methods employed for the study of the essential groups for enzyme activity.

Although the title is very general in nature, the second section on "Techniques for Metabolic Studies" deals with only certain limited topics in metabolic studies. The article* on assay of respiratory enzymes by B. Chance elaborates the various cytochrome systems and their measurement by the spectrophotometric technique. The articles on "Artificial Electron Acceptors in the Study of Dehydrogenases", "Study of Hill Reaction" and "Methods for Measurement of Nitrogen Fixation" consist of the important methods used in these studies. Of particular interest are the articles, "Micromethods for the Assay of Enzymes" by O. H. Lowry and "Histological Methods for Enzymes" by G. Gomori which are a collection of some very elegant methods for determining enzymes on a micro-scale.

The third section is devoted to a consideration of techniques for isotope studies. Here an attempt has been made to outline those aspects of the theory and practice of isotopic tracers which are most useful in the enzyme studies. For special details, however, it is necessary to consult several of the textbooks which have recently appeared on the subject. The first two articles deal with measurement of radioisotopes

and stable isotopes and also description of the types of equipment used. The important features of isotope studies such as the preparation, isolation and degradation of labelled intermediates which will help trace the pathways in metabolism have been outlined. In many of the articles in this section, the preparation, isolation and degradation of the various intermediates in the metabolism of carbohydrates, tricarboxylic acid cycle, purines, pyrimidines, amino-acids, steroids, fatty acids, phospholipids and coenzymes, involving mostly C^{14} labelling, have been described. Also, separate chapters have been included to deal with labelled compounds of isotopes of sulphur, iodine and oxygen.

The editors have stated in their Preface that "Certain articles are already in need of revision and that certain important new subjects are not covered at all", and they have promised to make up these deficiencies in a supplement. In such a fast-expanding subject as Enzymes, it is very difficult to keep pace with the progress for any kind of a comprehensive treatise without being out of date very quickly. In this respect the editors have done a commendable job in bringing together the basic methods involved in the study of enzymes in one volume such as the present. In the reviewer's opinion such a volume as this will be extremely useful not only as a reference work in the laboratory but also as a text-book for understanding the theoretical principles involved in such a study on enzymes.

P. S. SARMA.

Books Received

Polymer Reviews, Vol. 2. (*Linear and Stereoregular Addition Polymers; Polymerization with Controlled Propagation.*) By N. G. Gaylord and H. F. Mark. (Interscience Publishers Inc., New York 1, N.Y.), 1959. Pp. x + 571. Price \$17.50.

The Wealth of India—Raw Materials, Vol. V—H-K. (Council of Scientific and Industrial Research, New Delhi), 1959. Pp. 332. Price Rs. 30-00.

The Influence of Hormones on Lipid Metabolism in Relation to Arteriosclerosis. By Abraham Dury, C. R. Treadwell and others. (*Annals of the New York Academy of Sciences*, Vol. 72, Art. 14), 1959. Pp. 787-1054. Price \$4.00.

Hematopoietic Mechanisms. By W. S. Root and A. H. L. Alt and others. (*Annals of the New York Academy of Sciences*, Vol. 77, Art. 3), 1959. Pp. 407-820. Price \$5.00.

The Biology of the Amœba. By H. I. Hirshfield, E. Borysko and others. (*Annals of the New York Academy of Sciences*, Vol. 78, Art. 2), 1959. Pp. 401-704. Price \$ 4.50.

Organic Chemistry an Outline. By C. Hansch, G. Helmkamp. (McGraw Hill Book Co. Inc., New York-36, N.Y.), 1959. Pp. vi + 258.

The Structure of the Physical Universe. (Preliminary Edition.) By D. B. Larson. (D. B. Larson, 755, N.E. Royal Court, Port Land 12, Oregon), 1959. Pp. v + 218. Price \$ 6.00.

Text-Book of Physics. (Revised Edition.) By R. Kronig. (Pergamon Press Ltd., London W. 1), 1959. Pp. xiv + 961. Price 84 sh.

Radiopaque Diagnostic Agents. By M. H. Poppel. (*Annals of the New York Academy of Sciences*, Vol. 78, Art. 3). Pp. 705-1020.

The International Astrophysics Series, Vol. V. *Close Binary Systems.* By Zdenek Kopal. (Chapman & Hall Ltd., London W.C. 2; India: Asia Publishing House, Bombay-1), 1959. Pp. xiv + 558. Price 105 sh.

Reading German for Scientist. By H. Eichner and H. Hein. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1959. Pp. xi + 207. Price 30 sh.

The Living Body a Text in Human Physiology. 4th Edition. By C. H. Best and N. B. Taylor. (Chapman & Hall, London W.C. 2; India: Asia Publishing House, Bombay-1), 1958. Pp. xi + 756. Price 45 sh.

Grasslands. Edited by H. B. Sprague. (American Association for the Advancement of Science, Washington D.C.), 1959. Pp. xv + 406. Price \$ 9.00.

SCIENCE NOTES AND NEWS

Inheritance Study in Gram

Shri J. A. Patil, Department of Agriculture, (Bombay), Poona, reports that in crosses between the spreading type mutant in gram reported by Chavan and Argikar (*Indian Farming*, 1950, 40, 539) and the erect types Niphad 10, Niphad 30 and Niphad 31, a monogenic inheritance was found. The erect type was found to be the dominant character.

Award of Research Degrees

Andhra University has awarded the D.Sc. Degree in Pharmacy to Shri E. Venkata Rao for his thesis entitled "Chemical Investigations of Some Cardiac Drugs and Other Poisonous Plants of India" and D.Sc. Degree in Geology to Shri M. Subba Rao for his thesis entitled "Some Aspects of Continental Shelf Sediments Off East Coast of India".

The Osmania University has awarded the Ph.D. Degree in Chemistry to Shri T. Navaneeth Rao for his thesis entitled "A Kinetic Study of the Chain Photolysis of Hydrogen Peroxide in Aqueous Solution", Ph.D. Degree in Zoology to Shri Ram Mohan Todd for his thesis entitled "Studies on Parasitic Protozoa of Wild Mammals" and Ph.D. in Mathematics to Shri. V. Lakshmikantham for his thesis entitled "Studies in the Theory of Non-linear Differential Equations",

Essen & Co., Analytical Chemists and Assayers, Bangalore

Dr. K. R. Krishnaswamy, D.Sc. (Lond.), F.R.I.C., Retired Professor, Indian Institute of Science, has joined the Company as its Technical Director.

Instruments Symposium and Exhibition—1959

The Defence Research and Development Organisation of the Government of India held a Symposium on Instruments along with an Exhibition of Instruments designed, developed or produced in India, at the Technical Development Establishment (Instruments), Dehra Dun, on the 4th, 5th and 6th November 1959. The main objects of the Symposium were (a) to create a national awareness of the problems connected with the subject of instruments and instrumentation; (b) to review the existing state of instrument industry in the country and to suggest ways and means for its future development with a view to self-sufficiency; (c) to step up the research, design and development activities in this field; and (d) to provide a useful forum for mutual exchange of ideas and information on the various problems connected with the subject.

The Symposium was attended by over 260 delegates from more than 80 different organisations and institutions in the country. Dr. D. S. Kothari, Chairman of the Conference, gave the

opening speech. Shri O. Pulla Reddi, Defence Secretary, delivered the inaugural address to the Symposium and later opened the Instruments Exhibition.

First All-India Congress of Zoology—1959

The First All-India Congress of Zoology, sponsored and organised by the Zoological Society of India was held from October 24-28, 1959, at Jabalpur at the invitation of the Jabalpur University.

The Minister for Scientific Research and Cultural Affairs, Professor Humayun Kabir, inaugurated the Congress. Dr. M. L. Roonwal, Director, Zoological Survey of India, in his Presidential Address, emphasised the need for work on field ecology and taxonomy and the importance of the protection of wild life.

Abstracts of nearly 120 papers received for presentation at the sectional meetings were printed and issued in advance.

Disposal of Radioactive Waste

All available information indicates that in the not distant future the production of electric power from nuclear energy will be more economical than its production from the conventional fossil-fuel resources. How soon this will happen is dependent on how fast nuclear technology will advance. One problem of pressing importance in the development of nuclear plants is that concerning the Disposal of Radioactive Waste. Whatever methods of disposal are chosen they must have the overriding aim of not endangering man either immediately or in the long run. Atomic age must be a safe age, and Science must realise its moral obligations in regard to the problem of waste disposal.

These points were brought to focus at the International Conference on Radioactive Waste Disposal which concluded its one week session on 21 November 1959, in Monaco. The conference was attended by 308 experts from 32 countries and 11 international organizations. In the papers presented at the Conference and in the discussions that followed, the problem of waste disposal was discussed from all the major practical and theoretical points of view. It was pointed out that in the United States alone the nuclear power industry would have produced, by the year 2000, wastes amounting to 3 million curies of activity.

The three obvious sinks for the disposal of radioactive waste are the atmosphere, the ocean and the earth. An expert from Norway, speak-

ing of the potential suitability of the earth's atmosphere for disposal operations, said radioactive particles remained in the stratosphere for a period long enough to allow certain substances to become harmless before they returned to the earth's surface. A British Scientist described disposal methods at Harwell, where extreme care had to be taken because low level liquid waste was discharged, after special treatment into the Thames, which was the main source of London's drinking water. No solid waste was buried at Harwell in order to avoid any danger of seepage into the river.

A subject which provoked considerable discussion concerned waste disposal in the sea. A Soviet scientist said that research specially conducted for the purpose has shown that there are no stagnant zones in the ocean, but that the water circulates everywhere down to the ocean floor. Radioactive wastes dumped into the ocean at great depths are sure to rise to the surface. Strontium-90 and other radioactive substances will be assimilated by plankton, then by flesh-eating fish and will become a hazard to human life. Another opinion was that disposal in the ground was the safest method available today; the material should be enclosed in solid blocks of concrete or glass and stored at appropriate depths and under permanent human control. The problem of radioactive waste is really one of storage rather than of disposal.—IAEA News.

Potassium Reduces Strontium-90 Uptake in Plants

According to Dr. W. F. Libby the use of certain fertilizers may reduce the danger of radioactive contamination of the earth's soil. His research showed that the use of potassium—an ingredient of many fertilizers—reduced the amount of strontium-90 that is found in plants. Scientists are especially concerned about this atomic fall-out contaminant, since its too large a concentration in food products could conceivably lead to bone cancer.

Dr. Libby grew radishes from seeds planted in soil contaminated with known amounts of strontium-90. Other non-radioactive chemicals were also added to the soil to see if they would increase or decrease the amount of strontium-90 that ended up in the plants. Potassium was most effective in reducing the amount of strontium-90 taken into the plant. When added to the soil in small concentrations, it reduced radioactivity in the mature radish plants by as much as 40%.—ISLO News.

Cobalt-Platinum Magnetic Alloy

The outstanding magnetic properties of certain alloys in the cobalt-platinum series have been known to metallurgists for many years, but it is only recently that the properties of the alloy containing equal numbers of the atoms of each element (23.3% by weight of cobalt) have been fully appreciated. After heat treatment by a special process, it is claimed that the alloy has remarkable physical and magnetic properties: a remanence of 6400 G; a coercive force of 4,800 oersted; a BH (max.) of 9.2×10^6 G oersted. Moreover in the heat-treated state the alloy is magnetically isotropic. It is comparatively workable before heat treatment and can be machined, rolled and drawn without difficulty. It thus lends itself to the manufacture of magnets of complicated shape or extremely small size.—*J. Sci. Inst.*, 1959, 36, 416.

New Devices for Prospecting Minerals and Oils

A pulse neutron generator devised by Russian scientists is claimed to represent an effective technique for probing oil wells and obtaining cross-sections of oil-bearing strata and determining the water-oil boundary. The generator can operate in oil wells down to a depth of 3,000 metres at extremely high pressures and temperatures. It represents a long thin "shell" housing an ionic accelerator of a linear type, a system for maintaining high vacuum and a voltage source up to 100 kv. When lowered into the well the generator produces a neutron field the intensity of which gives an indication of the kind of liquid impregnating the rocks.

A new method of prospecting minerals is based on the use of pulsations of the earth's electromagnetic field, which are caused, in particular, by the sun's corpuscular radiations. It differs from the old methods in that the vertical, and not the horizontal, electromagnetic pulsations are used. A photoelectro-optical amplifier is used to measure the pulsations. The new method tested under field conditions is reported to have yielded positive results.—*Soviet News*.

Plasma Generator

To test new materials for use as nose cones in ballistic missiles, environmental conditions of temperatures and pressures associated with

the hypersonic re-entry of the missiles have been simulated in the laboratory. The plasma generator produced by the Avco Research Laboratory (U.S.A.) is capable of supplying the need. The generator heats gases to high temperatures by passing them through an electric arc. The gas to be heated is injected tangentially into the arc chamber, flows through the arc occupied by the arc discharge, momentarily becomes part of the discharge, and then flows through the throat of the anode into a plenum chamber. In the plenum chamber different portions of the gas mix to produce a great uniformity of plasma temperature and velocity at the exit nozzle. The working plasma is then discharged into free or controlled atmosphere. Although the unit is normally operated with air it may also operate as required with other gases including helium, argon and nitrogen.

The arc uses from 20 kilowatts to more than one megawatt of power. Temperatures obtain with the plasma generator have reached 18,000° F. The device also has been used in arc-heated wind tunnel experiments.—*J. Franklin Inst.*, 1959, 268, 335).

Survey of Earth's Magnetic Field

The scientific expedition, aboard the Zarya, a non-magnetic oil-and-motor schooner, organized by the Institute of Magnetism of the USSR Academy of Sciences, under the IGY program, has yielded fresh data and conclusions on the earth's magnetic field. Preliminary results show that the declination given by the existing nautical charts differs somewhat from the declination observed. The largest difference, about 3°, was observed in the Gulf of Guinea. Several magnetic anomalies were observed in the Atlantic, particularly in the Atlantic ridge zone. A number of magnetic anomalies were found also in the Indian ocean. This year the schooner has been equipped with two new instruments, an ionospheric station and a neutron monitor. The ionospheric station will make it possible to study in greater detail the distribution of electronic concentration in the equatorial zone. The neutron monitor designed to register the nucleonic component of cosmic rays will help to define the latitudinal effect, particularly the region of the magnetic equator.—*US Information Department*.

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